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From Secretary of State

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COLLEGE
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ELEVENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MICHIGAN.

FOR THE YEAR 1872.

BY AUTHORITY.

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The Board

State Board of Agriculture.

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Hon. GEO. W. PHILLIPS of Romeo.

His Excellency H. P. BALDWIN, } *Ex Officio.*
T. C. ABBOT, Pres't of the College, }

Richard Haigh, Jr., Secretary.

Ephraim Longyear of Lansing, Treasurer.

REPORT OF THE SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

LANSING, *December 31, 1872.*

TO THE LEGISLATURE OF THE STATE OF MICHIGAN:

In compliance with legal requisitions, the accompanying Report for the year 1872, with supplementary papers, is respectfully submitted.

RICHARD HAIGH, JR.,

Secretary of the Michigan State Board of Agriculture.

STATE AGRICULTURAL COLLEGE.

INSTRUCTION DEPARTMENT.

STUDENTS.

The College has had a total number of 131 students during the year. The Senior class numbered 5. This is smaller than the Senior Class has been for some years; in 1871 it numbered 12; in 1870, 12; in 1869, 11; in 1868, 10. There have been 19 Juniors; 36 Sophomores; 53 Freshmen; 9 in special studies, and 4 ladies. No ladies have been received into the Hall the present year. The number of the applications of ladies for admission is constantly increasing, and it is a matter of regret to the Board of Agriculture, and to the Faculty of the College, that we have not a Hall for ladies, connected with the institution. Reference is made to the Report of the Board for 1870, pages 12 and 13, for further remarks on ladies as students.

Two graduates of the College have been present as resident graduates; one pursuing the study of Chemistry, until lately he has been called to teach Agriculture and Analytical Chemistry in the University of Minnesota; the other as a student of Botany, except for about two months, when he acted as botanist to an exploring expedition sent out by the Kansas Agricultural College into western Kansas.

During the summer vacation of the union schools of the State, three of the principals of such schools presented themselves unexpectedly, and without knowledge of the intentions of each other, and desired lessons in Analytical Chemistry and

Chemical Manipulations. They were received, and their names appear as resident graduates on the catalogue.

In consequence of several requests coming from teachers of the State, it has been determined by the Faculty to form a class in Chemical Manipulations, on the first Wednesday in August, to continue three weeks. This will be free of expense to the teachers of primary, graded, and high public schools of the State. The members of the class will of course pay the cost of the materials they use in the laboratory.

The Faculty have taken a good deal of pains to make sure that each student goes over the entire ground in the studies that the class he is in may have studied. All examinations are in writing; the series of questions given to be answered are filed with the Secretary of the College. Students absent one-fifth of the time from any class, receive a private and special examination over the whole of the study pursued by the class.

Students who are deficient in more than one study at the beginning of any term are not permitted to re-enter the class until all, at least but one, of their back studies are made up, and a satisfactory examination passed in them. Students have not been permitted to change from the regular classes into the class of specials unless their standing and examinations would allow of their passing along with their class. They can enter only by falling back into a class that is to go over the studies in which they are deficient.

The following list shows the counties represented, and students from other States:

Barry County	1	Hillsdale County	1
Berrien County	1	Ingham County	10
Branch County	2	Ionia County	15
Calhoun County	2	Jackson County	8
Clinton County	8	Kalamazoo	2
Eaton County	5	Kent County	5
Genesee County	1	Lenawee County	4
Gratiot County	1	Livingston County	2

Mecosta County	2
Menominee County	1
Monroe County	1
Montcalm County	2
Muskegon County	2
Oakland County	11
Oceana County	1
Ottawa County	5
Sanilac County	5
Shiawassee County	6
St. Joseph County	12
Van Buren County	3
Washtenaw County	1
Wayne County	5

OTHER STATES:

Illinois	1
Indiana	5
Ohio	3
New York	2

The studies pursued during the year, and the progress of the classes therein, are shown in the following extracts from the reports to the Faculty of the College by the several members thereof.

The Seniors had Astronomy for six weeks, going through Peabody's Elements, paying special attention to the methods of finding data for the science, and the methods of demonstration. Sufficient advancement was made to enable them to continue the study at any time should they so desire. They have also been through the most important portions of Mahan's Civil Engineering.

During the Second Term the Seniors and Juniors together have had daily class-room exercises in Porter's Intellectual Philosophy. Each member of the class has written several essays and analyses.

Portions of the writings of Bain, Cousin, Hamilton, and others, have been read and criticised in the class, so that its members might understand what discussions are going on respecting perception, intuition, etc. In a series of familiar lectures and readings, there was given a connected view of the History of Philosophy.

Instead of using a text book on Political Economy, the Seniors this year received a course of lectures from the Professor in charge, intended to be more systematic in arrangement, more clearly confined to principles, and on some points connected with agriculture more suggestive, than any course of the same length from a text book could be made.

In French, the class have made the ordinary progress in grammar and pronunciation, and better than usual in the translation.

Fairchild's Moral Philosophy was completed in the ten weeks allotted to it, and the class seemed much interested.

In the study of Zoology, the Senior class received first a course of lectures on the history of Zoology and the different classifications of the most eminent writers on this subject This was followed by a more thorough study of Vertebrates.

A series of charts illustrating the diffierent branches, classes, and orders of the animal kingdom, prepared with great care and labor by the Professor in charge, were found to add much to the interest of the study, and to be of very great value to the class.

The commencement exercises of the Senior class passed off well. The orations, five in number, showed much care in composition, and were well delivered.

The introduction of Day's Praxis, by short courses, in different years, is regarded as having an excellent effect upon the general advancement in arrangement of thoughts, and in style of expression.

During the first term the Seniors received a course of lectures on Practical Agriculture, comprising the general principles of farm economy; manures—their management and mode of application; rotation of crops; preparation of the soil for particular crops; cultivation of crops; management of grass lands; stock husbandry; care of animals, and principles of feeding; fattening of animals; management of sheep. So far as possible the labor of the field is made to illustrate all these points. Many of the best works on these subjects, both American and foreign, are used for reference in connection with the lectures. This class also received a six weeks' course of instruction in Landscape Gardening, each student being required to form a plan in detail of some plat of ground, under some supposed circumstances.

In addition to the regular rhetorical exercises comprising essays and declamations, each member of the Senior and Junior classes has written and delivered in public, several orations during the year. They have made good progress, and the exercise has been found very beneficial.

In consequence of the non-completion of the new Laboratory in season for the usual instruction in Chemical Analysis to the Sophomore Class for the second term of last year, the lectures in Agricultural Chemistry usually given in the first term of the Junior year were given in the last term of the Sophomore year, and this Class pursued Analytical Chemistry during the first term of the Junior year. This Class received eighty-six lessons of three hours each. Each member of the Class analyzed at least one hundred different substances. Quite a large number made analyses of substances quantitively, determining the percentage composition of ores, marls, etc.

During the second term the Juniors received instruction in Chemical Physics; the recitations being fully illustrated by appropriate experiments. Twenty-seven lectures on Meteorology were given, in which the facts and principles of the science, so far as known, were placed before the Class, together with the results reached by the observations made by the United States Signal Service. In Physiology this Class received a course of lectures upon Comparative Osteology, comprising the anatomy, structure, and functions of all the bones, illustrated by skeletons; also, a course of lectures on the Circulatory System, illustrated by drawings. In addition, the Class has gone over nearly the whole of Dalton's Human Physiology. Whately's Rhetoric was studied through the entire first term by the Junior Class, and satisfactory progress made.

The Rhetorical exercises of the Juniors and Seniors have showed for the most part, care and labor. Especial pains have been taken to encourage strength and clearness in thought and expression.

The Junior Exhibition was held on August 28th, when seventeen orations, each of six minutes length, were presented before a large and apparently interested audience.

The Sophomore Class, in Rhetoricals, has showed great interest, and made praiseworthy efforts in this direction. In English Literature, the ground gone over has been much the same as usual, but the study has been more systematic and thorough. While Chambers' Cyclopedia was used constantly for reference and for critical reading, the instruction was embodied in a course of more than fifty lectures, the object of which was to give a connected view of the growth of the language, of the characteristics of definitely defined periods, with supposed influences at work in each to produce the next, and especially to select such authors and works for study as should give a clear view of the breadth of each period. The Class, numbering thirty-six, showed abundant interest, and made commendable progress.

The Class in Elementary Chemistry, including Sophomores and Specials, numbered forty-two. Eighty-three lectures and reviews were given, with ample illustration and experimental demonstration. In addition to the usual Class Exercises, one evening a week was spent in familiar conversation on chemical subjects, the students being encouraged to ask questions and bring forward any matters upon which they wish information. This same Class received instruction in Chemical Analysis; seventy-one lessons of three hours each, and fifteen of two hours each, including fifteen lectures on Blow-pipe Analysis. Each member of the Class analyzed one hundred substances,—some of them more,—and in addition, they made blow-pipe analyses of twenty-five substances. They also received instruction in Volumetric Analysis, making an accurate determination of the quantity of free alkali or free acid in thirty-five different substances or combinations. In Botany the Class spent twenty-four weeks during the year. For the first four or six weeks no lessons were assigned in books. Students were taught in the class-room to make critical examinations of specimens, and then tell what they had discovered. It was a matter of surprise and delight to the Professor in charge that so few things were overlooked. The rule has been to see the thing and want a name for it before learning the name. In this way the habit of observation has been cultivated, and the students have learned much without consulting their books or being told. Lectures were given upon Chemical Botany, and some other subjects in which the text-books were deficient. Each member of the Class was shown at least one hundred preparations of plants through the microscope. Much attention was given to Vegetable Physiology, and the natural orders of special economic value to the florist, gardener, and farmer.

The Sophomores received an eight weeks' course of instruction in Horticulture, using as text-books, Thomas' Fruit Culturist, Purdy's Small Fruit Instructor, and Henderson's Gardening for Profit. Practical illustrations were given in the orchards and gardens as far as possible.

The Freshman Class received a thorough course of instruction in Botany, the second term, studying the plants first and afterwards the text-book, after the same manner as the Sophomores. In Practical Agriculture the Class received instruction in the laying out of farms; arrangement and planning of farm buildings; farm implements; general principles of tillage; principles of drainage; laying out and construction of drains; methods of seeding; harvesting of crops; principles of stock-breeding; breeds of domestic animals,—their characteristics and adaptation to particular purposes.

This Class had a longer course than usual in Day's Praxis, going thoroughly over the chapters on description,—simple and abstract; analysis, division, and partition; exemplification, comparison, and contrast. They had frequent exercises in writing essays, and a course of familiar lectures on the elements of logic. In Mathematics the Class has pursued

Algebra and Geometry. Algebra was studied somewhat more than one term; good progress was made, and the most important portions of Robinson's University Algebra thoroughly understood.

On finishing the Algebra, Geometry was taken up and pursued for the remainder of the term. Two books were completed, and the balance of the book is to be studied during the Sophomore year.

The class studied Book-keeping six weeks, using Mayhew's text-book, and going thoroughly through with single entry, They were practiced in all the different forms of accounts. both from the book and extemporized in the class-room.

Following this, came Physical Geography, which was pursued during the remainder of the term. The text-book was completed, and they received in addition a series of lectures on the same subject.

It is a matter of gratification to the Faculty of the College that the standard of scholarship has been very materially advanced the past few years.

The institution, by its organic law, is required to admit graduates of the common schools, and it is to be hoped that they may continue to improve more rapidly, if possible, in the future than in the past. The foundation of the educational interests of the State is the common schools. On their advancement depends the advancement of the higher institutions, and more rapid advancement must be made by all, if Michigan maintains her high standing in this respect among her sister States.

In addition to the instruction given to the regular classes much labor has been performed in all the departments. In the chemical department meteorological observations have been taken three times a day, with wet and dry bulb thermometers, barometer, wind-vane, and rain-gauge. These observations are taken under the direction of the Smithsonian Institute, and are furnished monthly to that Institute. These monthly reports are compiled at the end of the year, and will appear as an appendix to this volume. These observations have been kept up and published in this way continuously for ten years.

Observations have been made on the ozone contained in the atmosphere, to assist in determining the influence of atmospheric conditions and fluctuations on health and disease. Also, observations on the ammonia contained in rain-water of each storm. These observations on ozone and ammonia have been made for nearly two years.

Analysis has been made of potatoes, to the vines of which, during the period of growth, Paris green had been applied, to destroy the Colorado potato-bug. This analysis was made to determine the fitness or unfitness of such potatoes as articles of food. The results have been already published in the newspapers, and show that the Paris green seems to exercise no deleterious influence whatever. Analyses have been made of human stomach in several cases of suspected poisoning. Analyses of water from Kalamazoo, Grand Rapids, and Blissfield, to determine its value for domestic or medicinal purposes. Analysis of thirteen specimens of soil from Province of Ontario, to determine its agricultural value. Analyses of specimens of soil for Flint & Pere Marquette Railroad. Numerous analyses of well water, suspected of sewage contamination.

It will not be out of place to say a word in regard to the new laboratory. After more than a year's use, the Professor in charge reports that for convenience of teachers and students alike, it fully meets every reasonable expectation. The abundant light and ventilation are above praise. Their influence is seen in the improved health and cheerfulness of the students who spend so large a part of their time in the laboratory. The self-ventilating hood, as planned for the great laboratory at Bonn, but here first tried in this country, proves so valuable an addition to the means of ventilation, and of removing offensive and deleterious vapors of every kind, that no laboratory will be considered complete in all its appointments which does not contain the self-ventilating hood. Their construction is so cheap, and their working so completely within control, that they will be considered a prime necessity in every chemical work-room.

The museum has received valuable additions, both by purchase, donation, and exchange. Fine specimens of mammals and birds, some of them very rare and valuable, a collection of Chicago relics, large numbers of geological specimens and fossils. Entomological specimens in great variety. Specimens of insects, beneficial or injurious, have been put under glass in a large case, and so labeled that the common and scientific name, and also how they are injurious or beneficial, can be seen at a glance. This is found to be quite an interesting feature. New cases have been put in, and many specimens re-arranged.

In the gardens and greenhouse much has been done, and many improvements made. The number of plants in the greenhouse has been more than doubled. Eighty plats of native and foreign grasses, each one yard by three, were planted in the spring. They have been of much service to students and farmers, and have attracted much attention from all visitors. Many of our most valuable grasses are similar in appearance, and need to be examined together to distinguish their differences. These plats afforded just such opportunity.

The crops in the garden have been good. Little more has been raised than was used by the boarding hall. Early in the spring the grounds were laid out by a competent landscape gardener. Locations were established for drives, walks, groups of trees, and several additional buildings. About thirty square rods of drives have been thoroughly repaired during the year, and quite an amount of tile laid in portions of the grounds needing it. A good many trees and groups of trees have been planted.

In the orchard experiments were tried in destroying the larvæ of the codling moth. Strips of woolen cloth, six to eight inches wide, were wrapped about the trunks of numbers of the trees. These were examined occasionally, and from five to forty insects were found in each cloth each time.

Some improvements have been made in the buildings. The garden barn has been moved into a more convenient and less conspicuous position. The farm horse-barn and piggery have been completed, and are giving excellent satisfaction. A large ash-house has been constructed of brick, for the use of the boarding hall and dormitories.

The College apiary shared the fate of nearly all the apiaries throughout the State during the winter of '71–2. In February it was found that the colonies were rapidly dying in the cellar, where they had been placed, as usual, in the beginning of winter. Seven colonies were entirely dead, and the remaining five exceedingly weak. In all the hives there was abundance of honey, but it was thin, and unpleasant to the taste. It was evident that the bees had diarrhœa, as the hives were besmeared, and from all arose an intolerable stench. The live colonies were immediately removed from the cellar, and placed on their summer stands. Believing the cause of disease to be poor quality of honey, one colony was placed in a clean hive, and given honey taken from the hives the previous fall. This colony began immediately to improve, while all the others died in a short time. The one colony left improved so rapidly that by the first of June it was strong enough to be divided. These two gave another strong colony the first of July, and the parent stock was again divided the first of August. Thus an increase has been made during the year of three colonies from one, and in addition to this, these colonies made 412 pounds of honey.

DONATIONS TO THE COLLEGE, 1872.

◆

From the **Department of Agriculture**:

Annual and Monthly Reports of the Department; Bulletin Essex Institute; Diseases of Cattle in the United States; Proceedings of National Agricultural Conventions—36 copies; four quarts Cooley Corn; eight quarts White Australian Spring Wheat; eight quarts White Schonen Oats; eight quarts Saxonian Barley; two packages Sugar Beets—White Silesian; two packages Sugar Beets—Vilmorin's Improved; eight quarts Silver Hull Buckwheat; sixteen quarts Tappahannock Winter Wheat; sixteen quarts White Touzelle Winter Wheat.

From the **Postoffice Department**:

Postal Laws and Regulations.

From the **United States Patent Office**:

Patent Office Gazette, Vol. 2, No. 1.

From the **Bureau of Education**:

Circular of Information for February, 1872.

From the **Hon. Z. Chandler**:

Report of Commissioner of Agriculture, 1870; copy of his Speech on Amnesty; copy of Senator Frelinghuysen's Speech on Sale of Arms to the French; six packages Tropical seeds; Congressional Globe, Parts, 1, 2, and 3 of 1870–71.

From **Rear Admiral B. F. Sands**:

Astronomical and Meteorological Observations for 1869.

From the **Secretary of State**, Lansing:

Joint Documents, 1871, Parts 1 and 2; Senate Journal, 1872; House Journal, 1872; Report of the State Pomological Society, 1871; Compiled Laws, Vol. 1; Edmonds' Impeachment Trial, Vols. 1 and 2; Senate Impeachment Journal, 1872.

From **Sellew, Adams & Co.**, Gowanda, N. Y.:

One Gowanda plow.

From **J. W. Porter**, Class '71:

Two specimens granite from the Soldiers' Monument, Detroit.

From C. O. PERKINS, Becket, Mass.:
Farmer's Accountant.

From Prof. W. J. BEAL:
Eight specimens Frear's Patent Artificial Building Stone; one specimen Portland, England, Cement; one specimen Michigan Lake Shore Sand; one specimen Joliet Marble; two specimens Lake Superior building stone; one specimen of Marble from Quincy, Ill.; two specimens of Pot-holes in Joliet Marble; two specimens Pressed Brick, Philadelphia and Buffalo; eleven specimens relics from Chicago fire; one specimen Sponge from Massachusetts Bay; one specimen Skeleton Frog; one specimen Skeleton Bat; five specimens Fossil Plants; Small Fruit Recorder and Cottage Gardener, Vols. II. and III., 1870 and 1871.

From E. J. INGALLS, Menominee:
A box of specimens from the iron regions.

From WILSON, HENKLE & Co., Cincinnati:
Ray's series, Higher Algebra; Ray's series, New Elementary Algebra; Schuyler's Complete Algebra; White's Arithmetics (three); Schuyler's Logic; Harvey's Grammars (two); Eclectic Geographies, (three); Cole's Institute Reader; Kid's Rhetorical Reader.

From M. S. SMITH & Co :
One Eight-day Office Clock.

From FRANK WELLS, class of '73:
Two stuffed birds—Cardinal Grosbeak.

From ROBERT BARKER, Lansing:
One cream-colored Brick.

From A. H. HAWLEY, ESQ., Mason:
One jug Maple Syrup.

From Dr. M. MILES:
Mineral Regions of Lake Superior; Senate Documents, Mich., 1839, 1 vol.; 1840, 2 vols.; 1841, 1 vol.

From Prof. BENJAMIN PIERCE, Supt:
Report U. S. Coast Survey, 1868.

From MISS HOWARD, Lansing:
Twenty-four grains of Wheat from Bitlis, Armenia, Turkey in Asia, sent by Miss Ely, missionary.

From J. M. TOWNSEND:
Seeds of Wild Oats from Sable Island, near Nova Scotia.

From the COMMISSIONER OF AGRICULTURE AND PUBLIC WORKS, Ontario, Canada:
Annual Report of Agriculture and Public Works, 1870, 1871; Report of Fruit Growers, 1869, 1871; Report of Entomological Society, 1871; Report on Colorado Potato-Beetle.

From J. M. **Burtch**, Grand Ledge:
Five specimens Fossil Rocks.

From **Charles J. Nall**, Detroit:
Nall's Mill—a combined fan-mill, seed-cleaner, and smut-machine.

From Mr. J. H. **Hubbard**, Lansing:
Cocoa Nut with outer covering, from Carthagenia.

From **Smith & Dixon**, Port Byron, Cayuga Co., N. Y.:
One sample steel skeleton Harvester guard.

From **Little, Brown & Co.**, Publishers:
Examination of Cannon Liddon's Bampton Lectures.

From Hon. S. O. **Knapp**:
Specimens of Fossil Wood, from Nashville, Tenn.

From **The Proprietors**:
Catalogue of Slamsondale Herd of Short-Horns, 1872—Geo. Murray, Racine, Wis.

From **Adam Lecompte**, Columbus, Ohio:
Fifty scions Old Adam Apple.

From A. J. **Cook**:
Specimens Petrifactions and Cocoons of Silk-moth, from California; specimens of Sulphur and Cinnabar, from Sonoma County, California; Coal, Fossil Shale, and Iron Pyrites from Corunna coal mines; specimens of Lotus from Raisin River, Monroe County; Buckeye and Paw Paw, from Benton Harbor; Fossils—Pentameris, Goniatites, Orthis, Trilobites, Spirifer, Holysiter, Orthoceratite, Feldspar, Horned Fish.

From H. A. **Engelhardt**, Author:
"Beauties of Nature combined with Art."

SECRETARY'S ACCOUNT.

◆

Receipts for the Year beginning Dec. 1, 1871, and ending Nov. 30, 1872.

DR.

To balance on hand, December 1, 1871		$1,961 15
cash at sundry times from State Treasurer, on account of current expenses		17,000 00
cash at sundry times from State Treasurer, on account of Agricultural College interest fund		7,184 03
cash at sundry times on account of sales of swamp lands		217 05
cash from receipts of the Horticultural Department		100 88
cash from receipts of the Apiary		81 70
cash from students on account of matriculation fees	$285 00	
incidental	685 60	
room rent	878 52	
chemicals	961 95	
tuition	120 00	
diplomas	25 00	
		2,456 07
cash from students on account of board and washing		5,690 26
		$34,591 14

CR.

By cash paid at sundry times to E. Longyear, Treasurer	$34,591 14
	$34,591 14

SUMMARY OF TREASURER'S ACCOUNT.

◆

E. LONGYEAR, *in account with the State Board of Agriculture:*

1872.	Dr.		
Nov. 30.—	To balance from last year	$774 90	
	cash at sundry times from State Treasurer and Secretary of College	84,591 14	
			$85,366 04

1872.	Cr.		
Nov. 30.—	By paid warrants Nos. 1625, 1637, 1641, and 1649 to 1846 inclusive	$34,314 93	
	balance on hand	1,051 11	
			85,366 04

It will be observed that the warrant summary accounts for the expenditure of $23,101 43, while the Treasurer's account shows warrants paid to the amount of $34,314 93; thus leaving an apparent discrepancy of $11,213 50.

This is explained by the fact that warrants were drawn and accounted for, in the warrant account of 1871, for just this amount in excess of those paid by the Treasurer, except warrant 1461, for $45, accounted for in the warrant account of 1870.

SUMMARY OF WARRANT ACCOUNT.

◆

For the year beginning Dec. 1, 1871, and ending Nov. 30, 1872.

[NOTE.—This Summary, together with the Statement of Indebtedness, show the expenditures of the College for the year ending Nov. 30, 1872.]

Paid expenses of State Board of Agriculture		$274 28
Salaries of officers		10,175 42
Expenses charged to account of offices of President and Sec'y of the College:		
Exchanges	$46 87	
Postage	43 59	
Advertising	75 95	
Furniture and repairs	10 70	
Current expenses	57 88	
		234 99
Farm Department:		
Warrants as in account of Superintendent of Farm	$300 00	
Other payments	146 79	
		446 79

NOTE.—See the Cash Account, the Statement of Receipts and Expenditures of the Farm Department, and the Farm Account, elsewhere in this report.

Horticultural Department:		
Moving and repairing barn	$109 47	
Building new privy	73 78	
New team of horses	338 54	
New Implements	46 53	
Plan for grounds	67 57	
Tile, lumber, and hardware for repairs and permanent improvements	210 01	
Greenhouse and seeds and plants	375 09	
Labor, expense of teams, manure, and other expenses	446 99	
		1,667 98

NOTE.—Students' labor is not included in the above.

Boarding Hall:		
New ash-house	$179 74	
Building repairs	51 98	
Wood car and track	21 46	
New furniture	100 47	
Current expenses	8,167 57	
		8,521 22

Farm House:		
Provisions	$272 16	
Furniture	80 49	
Current expenses	55 55	
		$426 95
Chemical Laboratory:		
Chemicals	$127 27	
Wood	56 81	
Current expenses	87 91	
		271 49
Library:		
New books		198 23
Museum:		
Models from U. S. Patent Office (express charges)	$148 85	
Specimens	90 05	
Current expenses	25 20	
		263 60
Apiary:		
Current expenses		12 45
College General Account:		
Insurance	297 80	
Expenses of President at Washington Agr'l Convention	97 89	
Wood for college hall	66 00	
Furniture and repairs	2 71	
Current expenses	144 68	
		608 08
		$23,101 43

FARM DEPARTMENT.

Cash Account for the year ending Nov. 30, 1872.

1872.	RECEIPTS.		
Nov. 30.—	Produce—grain, $6 88; stock, $1,592 58	$1,599 46	
	Warrants	300 00	
	From Sec'y, to pay accounts of last year	178 17	
	From Sec'y, to pay labor	10 00	
	For lumber sold (black walnut)	171 57	
	For old iron	18 00	
			$2,277 66
1872.	**EXPENDITURES.**		
Nov. 30.—	For labor	$695 70	
	Paid accounts of last year	178 63	
	Barn and office (construction)	132 18	
	For lumber	95 60	
	college	40 25	
	buildings—painting, $40 00; sand, $0 70	40 70	
	tile and bricks	91 30	
	lime	76 50	
	boarding hall	95	
	feed	294 81	
	straw	63 00	
	stock, including advertising	249 92	
	toll	11 08	
	seeds purchased	19 47	
	office expenses	20 85	
	implements	5 56	
	repairs of implements	10 15	
	Hildreth's bill (foundry)	33 61	
	Balance on hand	217 40	
			$2,277 66

FARM DEPARTMENT.

Statement of Receipts and Expenditures for the year ending Nov. 30, 1872.

RECEIPTS.

1872.			
Nov. 30.—	Warrants	$300 00	
	From Sec'y, to pay accounts of 1871	173 63	
	For farm produce	1,599 46	
	black-walnut lumber	171 57	
	old iron	18 00	
	Labor of students paid by college	2,800 68	
	Board of men at farm-house 155 weeks, at $4	620 00	
	Produce on hand Dec. 1, 1871	2,148 70	
	Account of last year with crops of 1872	201 66	
	Sundry unpaid bills	2,710 14	
	Bills paid by Secretary	141 21	
			$10,885 05

EXPENDITURES.

Permanent Improvements—Horse Barn and Office Construction Account.

1872.				
Nov. 30.—	Students' labor	$232 28		
	Men and teams' labor	94 05		
	Lime	72 45		
	Sand	22 00		
	Bricks	21 00		
	Masons' work on chimney	25 90		
	Plastering office	30 75		
	Lumber	285 98		
	Hardware	95 91		
	Pump and hose	38 56		
			$918 88	

Piggery.

Students' labor	$65 47		
Lumber	38 66		
Lime	19 28		
Sand	6 50		
		129 91	
Amounts carried forward		$1,048 79	$10,885 05

	Amounts brought forward		$1,048 79	$10 885 05
1872.	*Permanent Improvements—Clearing Stones, Stumps, etc.*			
Nov. 30.—	Field No. 1, labor	$6 51		
	No. 2, "	2 21		
	No. 3, "	6 56		
	No. 4, "	1 71		
	No. 5, "	108 03		
	No. 6, "	65 12		
	No. 8, "	35 21		
	No. 9, "	10 47		
	No. 12, "	54 20		
	College grounds	89 80		
	Grading drives	44 47		
			424 29	
	Draining.			
	Field No. 5, labor	$101 55		
	No. 6, "	14 28		
	No. 8, "	16 40		
	Tiles	58 30		
			190 58	
	Fences and Lane Road.			
	Labor	$72 20		
	Lumber	78 26		
			150 46	
	Buildings—General Account.			
	Labor on lumber (unclassified)	$59 11		
	Cash paid for lumber (unclassified)	83 70		
	Paints and painting (barns)	224 59		
	Hardware (unclassified)	105 78		
	Bricks (unclassified)	12 00		
			485 18	
	Total permanent improvement account	$2,299 20		
	College General Account.			
	Labor	73 98		
	Repairs of farm houses	23 00		
	Expenses	40 25		
	Items in unpaid account	11 80		
			149 03	
	Laboratory Construction Account.			
	Labor	$10 50		
	Hardware, G. & W.	14 73		
	Lime	15 50		
			40 73	
	Horticultural Department.			
	Balance of labor account	$33 11		
	Items in hardware bill	52 63		
			85 74	
	Amounts carried forward		$2,574 70	$10,885 05

	Amounts brought forward		$2,574 70	$10,385 05
1872.	*Boarding Hall.*			
Nov. 30.—	Produce	$956 80		
	Wood	480 03		
	Labor	57 42		
	Sundry items	3 20		
			1,497 45	
	Farm House.			
	Produce	$263 07		
	Wood	35 66		
	Labor	72 35		
	Unpaid account	16 69		
			387 77	
	Implements.			
	Shop account	$47 53		
	Farm account	100 67		
	General account	49 93		
	Repairs of implements—general account	59 18		
			257 31	
	Farm Office.			
	Labor (posting books)	$27 12		
	Current expenses	24 85		
	Furniture (new office)	45 60		
			97 57	
	Miscellaneous.			
	Toll	$11 08		
	Paid bills of 1871	187 98		
	Shop, current expenses	43 91		
	Coal tar	36 50		
	Blankets and harness	32 25		
	Repairs of buildings (labor)	19 03		
			330 75	
	Stock.			
	Purchases and current expenses		261 45	
	Current Farm Expenses.			
	Labor of students	$1,095 32		
	Labor of men and teams	1,098 92		
	Account of 1871 with crops of 1872	201 66		
	Seeds purchased	59 32		
	Plaster	7 20		
	Repairs of farm implements	59 00		
	Current barn expenses	13 40		
	Repair of fences	38 68		
	Produce on hand Dec. 1, 1871	2,143 70		
			4,717 20	
	Account with Crops of 1873.			
	Fitting wheat ground and hauling manure	$210 92		
	32 bushels seed wheat	48 28		
	Plowing for soiling crop	1 65		
			260 85	
			$10,385 05	$10,385 05

STATEMENT

Of Receipts and Expenditures of College Farm for the year ending December 1, 1872.

1872.	RECEIPTS.		
Dec. 1.—	Cash sales of produce	$1,599 46	
	Produce to boarding hall	956 80	
	Produce to farm house	268 07	
	Hay, 72 tons	720 00	
	Oats, 660 bu. @ 30c	198 00	
	Wheat, 475 bu. @ $1 50	712 50	
	Corn, 3,343 bu. ears @ 30c	1,002 90	
	Roots, 4,710 bu. @ 10c	471 00	
	Wool, 792 lbs. @ 30c	237 60	
	Corn-stalks, 57 tons @ $3 00	171 00	
	Oat straw, 12 tons @ $4 00	48 00	
	Wheat straw, 24 tons @ $2 50	60 00	
	Increase in value of stock	250 00	
			$6,690 33

1872.	EXPENDITURES.		
Dec. 1.—	Labor of men and teams	$1,098 92	
	Labor of students	1,095 32	
	Accounts of 1871 with crops of 1872	201 66	
	Seeds purchased	59 32	
	Plaster	7 20	
	Repairs of implements	59 00	
	Current barn expenses	13 40	
	Repairs of fences	38 68	
	Produce on hand Dec. 1, 1871	2,148 70	
	Profit to balance	1,973 13	
			$6,690 33

HORTICULTURAL DEPARTMENT.

Summary of Cash Account from April 1 to Nov. 30, 1872.

1872.	RECEIPTS.		
Nov. 30.—	Cash of predecessor	$17 60	
	Warrants	606 50	
	For green-house plants	190 17	
	vegetables	203 26	
	apples and pears	6 83	
	lime	1 60	
	implements sold	25	
	labor	2 87	
			$1,028 58

1872.	EXPENDITURES.		
Nov. 30.—	Paid Secretary	$270 97	
	for green-house	123 42	
	tools and repairs of same	66 88	
	seeds and Paris green for vegetable garden	45 28	
	manure	46 10	
	feed	150 64	
	harness repairs	15 89	
	shoeing horses	11 40	
	lumber for shop use	7 50	
	salt	2 00	
	grass-seed and labels for lawn	6 30	
	moving and repairing barn	126 77	
	labor (hired man)	41 01	
	toll, $4 00; tile, $19 89	23 89	
	pump, college use	16 85	
	new privy	78 73	
			$1,028 58

HORTICULTURAL DEPARTMENT.

◆

Statement of Receipts and Expenditures for the year ending Dec. 1, 1872.

RECEIPTS.

Cash from last year	$17 60
Warrants	606 50
Produce and plants sold	400 26
Lime and implements sold	1 85
Cash for labor of students	2 87
Students' labor paid for by college	984 80
Labor of farm department on hay	49 56
Bills paid by Secretary and other officers	1,598 17
Board of gardener and teamster	274 95
Produce on hand Dec. 1, 1871	116 00
Unpaid accounts	82 32
	$4,183 88

EXPENDITURES.

A.—OUTSIDE OF THE DEPARTMENT.

Treasury:			
Paid over to the Secretary of the college			$270 97
Boarding Hall:			
Produce furnished it	$337 46		
Keep of B. H. horse (cost)	80 63		
Labor	2 15		
		$370 24	
Farm House:			
Produce furnished			50 86
Chemical Laboratory:			
Labor and teaming			8 06
Farm Department:			
Labor and team			20 95
College General Account:			
Work on college hall		$2 81	
Fighting fire		91	
			3 72
New privy—construction			73 73

B.—Within the Department.

Permanent Improvements—Buildings:			
Moving and repair of barns	$235 35		
Floor of basement of College Hall	22 60		
		$257 95	
Grounds:			
Pump near College Hall	$16 85		
Stumping	17 62		
Grading	10 15		
Drainage	72 22		
Construction of road and carriage turns near Boarding Hall	275 55		
Evergreens purchased to be used on the grounds	82 32		
		474 71	
			$722 66
Stock—new:			
Team of horses	338 54		
New implements	87 68		
Experiments with grasses	7 17		
		$383 39	
Current Expenses—Green-house:			
Wood, 1871-2	$100 00		
Seeds, plants, pots, and repairs	329 06		
Gardener's wages	332 81		
		761 87	
Orchards:			
Apple orchard	$14 69		
Pear orchard	11 15		
Small fruit orchard	24 78		
		50 62	
Vegetable Garden:			
Seeds and Paris green	$45 23		
Labor, team, and manure	700 61		
		745 84	
Unclassified Expenditures:			
Care of grounds and drives	$38 45		
Care and repair of implements	165 98		
Care of teams by students	3 23		
Office work and special duties for the department	86 52		
Toll	4 00		
Wages of teamster	41 01		
Salt	2 00		
Lumber for use in shop	7 50		
Shoeing horses	11 40		
Repairs of harness	15 39		
Feed	150 64		
Unpaid bills in favor of department	3 88		
Error in estimating wages of students in above charges	21 07		
Produce on hand Dec. 1, 1871	116 00		
		667 57	
			2,225 40
			$4,133 88

THE AGRICULTURAL COLLEGE.

CONSTITUTIONAL PROVISION.

The Constitution of Michigan, adopted August 15, 1850, provides, in Article XIII., as follows:

"SEC. 11. The Legislature * * shall, as soon as practicable, provide for the establishment of an Agricultural School." * *

ACT OF ORGANIZATION.

In order to carry out the foregoing provision of the Constitution, the Legislature in 1855 passed an "Act for the establishment of a State Agricultural School."—[*Compiled Laws, 1857, page 723.*

LOCATION.

The act for the establishment of the Agricultural College provided for the selection and purchase of a site for the College. It was to be "within ten miles of Lansing," and on "not less than 500 acres in one body," at a cost not to exceed $15 an acre.

On the 16th of June, 1855, the location of the College was fixed upon. The tract consists of 676 57-100 acres, lying on both sides of the Cedar river, about three and a half miles east of the Capitol. About three acres of the land was cleared at the time of purchase,—the conditions prescribed by law, as to price and nearness to Lansing, very much restricting the choice of a site. The conveyance is made to the State of Michigan.

OPENING OF THE COLLEGE.

The College was put under the supervision of the State Board of Education (*Compiled Laws, 1857, page 724*), where it remained until the close of the year 1860. The Board having erected a College Hall, a boarding hall, a brick barn, and purchased some farm implements, stock, etc., opened the College to students May 13th, 1857. The students worked three hours daily, and within a year 60 acres were brought under cultivation. The next year four brick dwelling-houses were erected, and a small wooden house purchased and repaired for the occupancy of the foreman of the farm.

The four years of the College under the supervision of the Board of Education were such as to tax the wisdom and patience of the Board. The first outlay for the College had exceeded their expectation, and the institution was in debt at the end of the second year. No railroads came within twenty miles of the College, and the uncultivated grounds presented few attractions to the student.

The Board left the institution at the close of the year 1860 virtually free from debt, leaving undrawn from the State Treasury $3,300 of the appropriation for 1859–60,—the barn and bridge, for which estimates had been presented to the Legislature, not having been built. The appropriation for 1861 was reduced by $3,500, on account of this balance.

RE-ORGANIZATION.

In 1861 (*Act No. 188, Laws of 1861*), the Legislature, acting in accordance with a recommendation of the State Board of Education (*Joint Documents, 1861, No. 5, pages 14 and 131*), transferred the charge of the College to a State Board of Agriculture. (*See below.*)

The act has been amended several times. As it now stands (*Compiled Laws, 1871, Vol. I., p. 1176*), it makes, among others, the following provisions:

"The Agricultural College shall be a high seminary of learning, in which the graduate of the common school can commence, pursue, and finish a course of study, terminating in thorough theoretic and practical instruction in those sciences and arts which bear directly upon Agriculture and kindred industrial pursuits.

"A full course of study in it shall embrace not less than four years.

"It shall combine physical with intellectual labor, and require, with some exceptions, three hours' labor each day from each student.

"In assessing the price of board, it shall be so estimated that no profit shall be saved to the institution, and as nearly as possible at the actual cost.

"The College shall have power to confer degrees."

STATE BOARD OF AGRICULTURE.

The same act, section 1, constitutes and establishes a State Board of Agriculture, a body corporate, to consist of six members, in addition to the Governor of the State and the President of the State Agricultural College, who shall be *ex officio* members of the Board.

The term of service is six years,—two going out of office the third Wednesday of January, or when their successors are appointed, every second year.

The vacancies thus created in the Board are filled by the Governor, by and with the consent of the Senate, in such a way that one-half the appointed members shall be practical agriculturists.

Other vacancies are filled by the Board.

The members of the Board have their traveling and other expenses paid while employed on the business of the Board, but they receive no compensation for their services.

CONGRESSIONAL GRANT OF LANDS.

An act of Congress approved July 2, 1862 (*U. S. Laws 1862, Chapter CXXX.*), donated to each State public lands to the amount of 30,000 acres for each of its Senators and Representatives in Congress, according to the census of 1860, for the "endowment, support, and maintenance, of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts."

Section 4 of the act provides that all the moneys derived from the sale of the land shall be invested in "safe stocks,' yielding not less than five per cent per annum upon the par value of said stocks, and that the capital so invested shall remain forever undiminished, the interest alone being used for the support of the college.

Section 5 provides that "No portion of said fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings."

Section 3 provides that all expenses of management, etc., of the lands and of the moneys received therefrom, shall be paid by the States, "so that the entire proceeds of the sale of said lands shall be applied, without any diminution whatever, to the purposes for which the grant was made."

ACCEPTANCE AND DISPOSAL OF THE GRANT.

In anticipation of the Congressional grant of lands the Legislature of 1857 enacted (*Compiled Laws of 1871, page 1277*), that the State hereby accept any such grant or donation of lands upon the conditions upon which such grant or donation is or may be made, "which terms, trusts and conditions are hereby declared to be obligatory on this State." In February, 1863 (*Compiled Laws, 1871, page 1271*), the grant of lands was formally accepted by the Legislature.

A Land Grant Board was established, consisting of the Governor, Auditor General, Secretary of State, Treasurer, Attorney General, and Commissioner of the State Land Office, for the control and management of the selection, sale, and investment of the moneys accruing from the sale of the lands. The law constituting this Board is unrepealed, but their duties are much restricted through the operation of Act 68, 1871. The Board had invested $15,000 in war bounty bonds. These were retired, and the $15,000 added to the Agricultural College Fund. (*See Auditor General's Report, 1871, appendix, page 27.*)

The provisions of the Act 68, 1871, are as follows: (*Compiled Laws, 1871, page 1380,* § *3934*).

"The money received from the sale of said lands shall be paid into the State Treasury, and the amount thereof shall be placed to the credit of the Agricultural College fund, upon the books of the Auditor General, to constitute a perpetual fund, the capital of which shall remain forever undiminished; and the annual interest thereon, computed at seven per cent, shall be regularly applied, under the direction of the State Board of Agriculture, to the support and maintenance of the State Agricultural College."

LAND GRANT FUND.

The Congressional grant of lands was 240,000 acres. The lands have all been selected and the patents secured. The lands patented fall short of 240,000 acres, "so that the amount received by the State will be 235,673 37-100 acres" (*Report of the Commissioner of the Land Office, 1870, page 7*). "This deficiency has arisen, in part, from the ruling adopted by the general Land Office, by which all deficient fractional descriptions were computed as full, and all surplusage when they overrun was charged to the State, and in part by the selection of a few double-priced lands lying within the railroad limits."

The minimum price fixed by law (*Compiled Laws, 1871, p. 1279,* § *3929*) is $3 an acre; one-half down, the balance at the option of the purchaser, with seven per cent annual interest on the unpaid portion. In case the land is valuable chiefly for timber, the minimum price is $5 an acre, the whole payment to be made at the time of purchase.

There were vacant and subject to sale Oct. 1st, 1872, 188,440 acres of these lands. (*Gov. Baldwin's Message, p. 10.*)

The College Fund September 30, 1872 was as follows:

Trust Fund, in the hands of the State, at 7 per cent interest	$73,608 92
Due from purchasers, on part-paid lands, at 7 per cent interest	81,184 75
Total	$154,793 67
The annual interest of which is	$10,835 55

Should the unsold lands prove sufficiently valuable to bring $3 an acre, the total endowment of the College will be about $700,000, and its yearly income $49,000. This income will be only sufficient to sustain a good Agricultural and Horticultural School, without affording means to develop other and desirable branches of instruction.

APPROPRIATIONS.

The appropriations that have been made to the College lands up to December 1st, 1872, since it came under control of the State Board of Agriculture, have been as follows:

1st. Swamp lands in four townships of Clinton and Ingham counties (*Compiled Laws, 1871, p. 1184, § 3565*), 6846 9-10 acres, from sales of which have been realized (Dec. 1, 1872), the sum of	$36,996 04
2d. The Agricultural College interest fund (the Congressional grant), of which the receipts to the College up to Dec. 1, 1872, have been in all	13,730 36
Total from lands	$50,726 40

APPROPRIATIONS OF MONEY.

3d. For current expenses, twelve years, from 1861 to 1872 inclusive, expended by the State Board of Agriculture	$178,500 00

4th. For a new hall (1869)	$30,000 00
5th. For heating apparatus and other furniture for new hall (1871)	6,000 00
6th. For a new chemical laboratory (1871)	10,000 00
Total	$224,500 00

EXPENDITURES.

1st. Swamp land receipts, $36,996 04. These have been chiefly expended in building barns and other erections. The interest of the Agricultural College Fund cannot be so applied, by the terms of its appropriation by Congress, and the Board have relied chiefly on these receipts for such expenditures. Amongst the more prominent of these expenditures are the following:

For ditching and improving the swamp lands, in order to facilitate the sale of them	$3,807 27
For museum of geological, mineralogical and conchological specimens	1,200 00
Erection of green-house and garden barn	2,400 00
Erection of farm house	3,150 00
Erection of sheep barn, about	2,000 00
Erection of cattle barn, about	2,000 00
Erection of cattle shed	1,186 47
Erection of bridge over Cedar river	750 00
New roofing of boarding hall	316 64
Extra construction and fixtures of new hall	14,700 00
Extra construction of chemical laboratory	1,507 13
Horse barn (1871), and piggery	2,500 00
Addition to Professor's house	771 06
Barn to Professor's house	300 00
Ash-house to boarding hall	179 74

Repairs and furniture on account of barns, houses, and halls, will more than consume the balance of these receipts from the sale of swamp lands.

2d. The interest of the Agricultural College Fund, $13,-

730 36, has been paid into the College treasury, and gone to pay for current expenses, general improvements, etc.

3d. Appropriation for twelve years, 1860 to 1872 inclusive, $178,500. As all the receipts of the College not named above have been inconsiderable, this sum, giving an average of $14,875 00, together with the receipts from the Agricultural College Interest Fund, has paid the expenses of the State Board of Agriculture, the salaries of officers, and the other current expenses of the College, for the draining, fencing, road-making, stumping, and other improvements on the farm, for the improvement of stock, for new implements, chemicals, increase of library, etc., etc., for twelve years.

4th, 5th, and 6th. These sums were expended for the objects for which they were severally appropriated.

PROPERTY OF THE COLLEGE.

A.—*Not at the College.*

The lands of the Congressional grant unsold, 188,440 acres.

The Agricultural College Fund, yielding interest at 7 per cent	$154,793 67
Swamp Land, being a portion of what is popularly called the "Big Marsh," 227 acres, worth, probably, when a sale can be made, $10 00 an acre	$2,270 00
Swamp Lands adjoining Big Marsh, 195.17 acres	$1,561 36
Swamp Lands, detached lots—in Bath township, 920 acres; DeWitt township, 40 acres; Lansing township, 120 acres	$3,240 00

B.—*At the College.*

1st. A farm of 676 acres. It was purchased at $15 00 an acre, with but three acres cleared. It now has about 350 acres cleared, most of it free from stumps; it has farm roads, fences, drainage, orchards, and general improvement; and is worth $70 00 an acre aside from buildings	$47,320 00

Buildings as follows:

Farm Buildings—		
Cattle barn and shed	$3,200	
Sheep barn	2,500	
Horse barn	3,000	
Piggery	2,000	
Brick work-shop	600	
Garden barn	600	
Certain inferior structures, — blacksmith shop, tool house, experiment feeding house, and others, are not included in the above,—value, say	400	
Total farm buildings		$12,300 00
Buildings for indoor instruction—		
College Hall	$15,000	
Chemical Laboratory	12,000	
Green-house	800	
Total of this class		$27,800 00
Dormitories, dwellings—		
New Boarding Hall	$45,000	
Old Hall	15,000	
Farm House	3,500	
Four brick Cottages	12,000	
Herdsman's house	600	
Barn at one of the dwelling houses	300	
Total of halls and dwellings		$76,400 00
Total value of buildings		$116,500 00
Value of the Museum, Cooley Herbarium, Smithsonian Institution deposits, Michigan Geological Survey specimens, and other collections		$4,000 00
Value of Library, 2,800 volumes		6,000 00
Stock, etc.—		
Short-horn cattle	$3,400 00	
Devon cattle	1,400 00	
Ayrshire cattle	1,375 00	

Galloway cattle	$300 00	
Jersey cattle	200 00	
Grade cattle	1,080 00	
Sheep	696 00	
Swine	600 00	
Six horses, farm	800 00	
Three horses, garden	340 00	$10,191 00
Implements—		
Farm, etc.	$2,314 80	
Horticultural	939 10	$3,253 90
Furniture, movable property—		
Boarding hall	$2,436 69	
Farm office	90 00	
Farm house	100 00	
College hall	620 00	
Laboratory	40 00	$3,286 69
Green-house plants	$2,127 75	
Apiary, stock and furniture	116 00	
Mathematical instruments	100 50	
Entomological cases, etc.	198 50	$2,542 75

INVENTORY SUMMARY.

Farm of 676 acres	$47,320 00
Buildings	116,500 00
Stock	10,191 00
Implements	3,253 90
Library, museum, and apparatus	10,299 00
Green-house plants	2,127 75
Apiary	116 00
Furniture	3,286 69
	$193,094 34
Produce on hand	2,436 45
	$195,530 79

THE LABOR SYSTEM.

One of the distinguishing features of the Agricultural College is its labor system.

Unless physically disabled, all students are required to work three hours daily for five days a week. Labor is furnished on Saturday to those wishing it, and a higher rate of wages is paid for all labor in excess of the required labor.

The Sophomore class spend the entire year on the farm, and the Junior class on the gardens. Other students alternate between the farm and garden, a portion being transferred once a month, in such a proportion that two-thirds of the entire force is upon the farm, and one-third upon the garden.

Blanks are furnished by the College, and on these the students are required to furnish an account of their labor once a fortnight. These blanks are examined by the foreman of the department in which the labor was performed, and corrected to conform with his account. They are then passed into the hands of the Secretary and recorded; and at the end of the quarter the student receives credit on his board account for the labor performed during that quarter.

The labor is considered as much a part of the course of instruction as the text-book exercises, and much time and pains are taken by the officers in charge to make it instructive.

This, of course, makes the labor of less value to the institution, and necessitates a low rate of wages.

Seven and a half cents is the maximum for required labor, and twelve and a half for extra.

The president and secretary of the College, and the superintendents and foremen of the departments, constitute a committee on establishing the rate of wages, which is done at the close of each quarter.

Pains are taken to make the ratio as fair and impartial as possible, and much importance is placed upon the quality of the work performed, the interest displayed by the student in the work, and his prompt attendance.

It is believed that the labor system is one of the most valuable portions of the course of instruction.

It is not expected that a student will become thoroughly efficient in all the practices of agriculture. That requires much more time devoted exclusively to one branch than is here given to a great number. The labor is found to have a beneficial effect upon the health of the students. The tendency is toward forming and keeping up habits of industry, towards the elevation of labor, and the uprooting of the idea that labor is degrading. The success of the system is believed to be due in a great measure to the fact that *all* are required to work. No class is exempt.

THE GRADUATES OF THE COLLEGE.

The occupation of the members of the graduating class of 1872 is not known.

Of the 68 graduates of the years 1861 to 1871 inclusive, the occupations are as follows:

Died in the army before engaging in business	2
Farmers and Horticulturists	30
Teachers in Colleges, and having charge of Farms or Horticultural departments	5
Teachers in Colleges, but having no charge of College Farms	3
Student in Chemistry	1
Engineers and Surveyors	3
Manufacturers	1
In Medicine, or Drug Stores	6
Lawyers	8
Merchants, Agents, etc.	4
Clergymen	1
Teachers, not in Colleges	4

Fifty-eight of these graduates spent four years at least at the College, all the others spent three. The average age at graduation is 22 1-5 years. More than one-half the number depended in a large degree—some of them entirely—on their earnings for the means of gaining an education.

Graduates of the College form part of the Faculty of Instruction in Cornell University, Wisconsin University, Minnesota University, Iowa Agricultural College, and our own Agricultural College. One was selected by Col. Capron to go with him to Japan, in the agricultural service of its Emperor. One gained the first Walker prize for an essay on a topic assigned by the Boston Society of Natural History, and was Assistant Director in an exploring expedition sent to the Valley of the Amazon. Another was made Botanist of an expedition sent out from a neighboring State into Western Kansas and Colorado. Another is the Entomologist, and still another is the Meteorologist of the State Pomological Society, and still another is Secretary of the State Bee Keepers' Association. Two of them have charge of divisions as Assistant Engineers on railroads. Three of them have had places on the Editorial staff of agricultural papers. Two now farmers have of their own accord given up good places in the Faculties of Agricultural Colleges, and the clergyman has been for several years the president of a farmers' club, whose weekly attendance averages over three hundred persons, and most of the lawyers are not infrequent writers on the subject of agricultural education.

The showing is far more favorable than was hoped for by the friends of the institution, and varies greatly from the careless assertions commonly made on the subject by those unacquainted with the facts in the case.

And, indeed, if there is any way of acquiring an education without losing interest in farm work, it would seem to be that in use at the College. Three hours daily labor keeps them used to farm work. A large part of their studies is of a sort to find illustration in the employments in which they are busied while at labor, and the entire surroundings and spirit of the place is in harmony with agricultural and horticultural pursuits. These influences are not to be measured by a count of the graduates that become farmers. Education in the community at large is in a great degree what its highest institutions of learning make it. Historically the high institutions of learning come first, and education is diffused through their influence; and practically these institutions shape the opinions of men as to what an education is, and for what pursuits it is needful. They have hitherto taught the people that it is needful for law, and medicine, and divinity, but that we must hesitate to call an engineer, as a chemist, learned, however eminent in knowledge and skill of his art. As to farming, the general impression finds expression in the sentiments of the London Times, that a farmer has no need of more than the merest elements of an education. But such sentiments are undergoing a change. The need and the value of intelligent educated farmers is becoming recognized more and more, and the value of an institution that shall furnish the needed education without unfitting in any way for the farmer's life, is increasing rapidly, and will continue to increase as its graduates make their influence felt throughout the land.

RURAL ADORNMENT AND BEAUTIFYING HOMES.

BY THE HON. A. S. DYCKMAN.

To promote his physical and moral welfare, bring gracious blessings on his head, kindle the light of love upon his hearthstone, give him true respectability, and make the strong brown hand of labor outshine the *lily* that languishes in gloves and idleness, the farmer must decorate his home with trees and flowers, and not neglect the amenities of life in the cultivation of his acres.

This necessity, although not primary to human existence, is nevertheless fundamental in higher civilization.

He, the labor of whose thoughts is for subsistence only, must be content with his small share of the beatitudes of life, and plod his weary way in oblivion of the wondrous beauties attendant upon every step in the green earth: flowers that lift their bright coronals in mute authority of loveliness; vegetation displaying its myriad forms of grace; the insect populace filling the world with fluttering life; birds that pour their loveborn raptures into song, and the over-bending heavens, out of mysterious depths, revealing all the delicate pencilings of light and shadow that make up the universal picture of life.

But he who studies to discern the secret springs whence nature pours her copious benefactions, cannot fail to see how, under the hand of the Great Architect, *beauty* is inwoven in every design, and his heart must swell with reverent admiration at the thought everywhere presented, that the hand of Divine labor is skilled in the infinite perfection of arts, and is only satisfied with the last line and tint of possible decoration in alliance with uses.

These studies are man's birthright, and enjoin a sacred duty, by diligent attention, to deserve and enjoy them. And the devotee is rewarded in the very exercise of helping these beauties in their efforts to illustrate the divine perfection in the cathedral of nature. The living drapery of green, the floral gems, and aisles of light cast their sweet impressions within the heart, dispelling the shadows, and filling with a purer inspiration.

Who, knowing and feeling this, would turn away to taste the poison of sin, or seek for pleasure along the treacherous path of dissipation?

Let us glance at the department of flowers.

Whether we run to meet them in the wild wood, sit in their dear society under the shades of home, or meet them in the city's crowded mart, at the altar of divine worship, or the shrine of departed friends, in their various language is still repeated the great thought of the poet, "A thing of beauty is a joy forever."

Whether draping some festive hall in graceful festoons and pendant wreaths, or grouped into forms of christian heraldry; whether decking the patriot's grave, or garlanding the brow of beauty, the influence of flowers is elevating, refining, and ennobling.

He certainly should not be burned as a heretic, who believes in that transmigration by which the spirit of flowers may animate the soul of man with radiance of immortal beauty.

Every farm house should have flowers, with every mother a florist, and every fair daughter a happy student of grace in nature. Every father should be a patron of home, and every son feel its attractions stronger than the wiles of idle pleasure.

Many such homes, to the glory of Michigan, bright centers of influence, are laying deep the foundations of our hope in Christian liberty: for the State must rest upon these.

Mark how this influence will extend in a community—for we copy what most we advise.

Then what more desirable thing than to have young ladies and gentlemen educated in a school that shall qualify them to take this high position in life,—and what better place for such discipline and instruction than the Agricultural College?

But ornamental tree planting greatly deserves attention. How often, and with what pleasure, do we revert to our childhood days in recollection of the trees that annually spread their bright banners of bloom to herald the summer, and against the fiery rays of that summer, hung, just above our happy heads, their million shields of green; and in the golden autumn, upon the mosiac of rustling leaves, dropped their fruit treasures at our feet.

Their broad branches reaching to Heaven, or bending gracefully to earth, great trunks bearing all their wealth of top defiantly against the whirlwind and the storm, and their fine spray, presenting delicate wave-lines to the breeze, as if repeating the deep mysteries of the ocean: these come flooding the memory, until the present, with its cares and disappointed hopes, is drowned in a sea of delight.

The God that has given us capacities and opportunities for this enjoyment, has also enjoined the duty to transmit even a fairer heritage to our children.

In many cases it is impossible, in clearing away immense forests, to save trees from the all-devouring flames. But in any case, shall we be satisfied with a bleak and treeless landscape?

Shall not the wild trees of such various form and flower and foliage, that gave to the Michigan of forty years ago a beauty no art may ever restore, at least be perpetuated along every wayside to break the force of driving winter storms?—storms that sweep the protecting snow from fields of grain and grass and orchard, and come with fearful penetration to shivering flocks and herds.

It has been proposed to institute an annual tree-planting *festival.*

This might be easily done by concert of action among farmers through their associations, and the governor of the State might help its general observance by proclamation appointing the day.

That there is a growing love for rural decoration there can be no doubt.

Economy in expenditures, already a necessity, is in the direction of an educated taste, whereby proprietors may superintend their own improvements, and in such manner that all patching and replanting may be avoided.

To this end may not the Agricultural College properly devote a share of attention? This question is answered by the provision for a new greenhouse and other improvements upon the college grounds.

If a separate place could be devoted to native plants, grown in something like their wild condition, showing the attractions of an original Michigan landscape, historical as well as beautiful, would it not be an unique, valuable, and interesting public park? Would it not be one of the finest collections in the country, valuable to the student in botany, and creditable to the college?

THE DAIRY.

MAKING, CURING, AND MARKETING CHEESE.

ADDRESS OF X. A. WILLARD AT THE ANNUAL MEETING OF THE MICHIGAN DAIRYMEN'S ASSOCIATION AT ADRIAN, FEBRUARY 13, 1873.

Mr. President, Ladies and Gentlemen:

It is a gratification to me to be present at a convention of Michigan dairymen. I have high respect for the people of this State, among whom I esteem it an honor to have many warm and steadfast friends. I think you have done well to organize a State dairymen's association in Michigan. It means progress and improvement in a specialty which, of late years, has made rapid advance towards perfection. These associations have become distinguished as among the remarkable educators of modern times. The history of organizations for the discussion of topics relating to the dairy, goes back no farther than January 6, 1864. The first convention, occurring at Rome, N. Y., was most remarkable in its results. The call was made by about forty leading cheese manufacturers and dairymen, among whom Jesse Williams, the originator of the factory system, was prominent. There was an immense gathering, crowding the largest hall in the place, and people in all parts of the State were anxious to get newspapers reporting the meeting. Since that time there has been a large number of dairy organizations formed, State and local, and the knowledge diffused on this subject is extensive, and its value can scarcely be estimated. I think I may safely say that there is no branch of agriculture that has made such rapid strides as that relating to the dairy. I think there is none in which you will find minds more intelligent, or more ripe for investigation. I know it is sometimes said that the factory system and these dairy conventions have been an injury to the dairy business. There is nothing more illogical or illusory. Had it not been for the factory system, and the spread of intelligence, which has exerted such a power in the education of manufacturers, the dairymen, as a class, would long since have been ruined. Contrast the general product of cheese to-day with what it was so late back as 1860. In 1869 Samuel Perry, of New York, contracted the great bulk of cheese made in the State at ten cents per pound. Much of this cheese was so poor, so utterly worthless as an article of food, that it had to be thrown into the docks. We had no name abroad, and our cheese in England was only considered fit for paupers or people of the lowest class. Even this class took it as a necessity, and because it could be had for a mere trifle. There were immense losses every now and then among persons who handled cheese, on account of its inferior quality and the difficulty of keeping it. Do you suppose that without this flood of intelligence that has been poured in upon us the cheese of to-day would have been any better than the cheese of 1859?

Why, my friends, we have revolutionized the feeling in England, and forced that nation to admit that the best American cheese is quite equal to the best English manufacture; while the bulk of our export is regarded as superior to the bulk of English make. The English people find it more and more difficult to compete with us in quality, and are now turning their attention to the factory system as a means of solving this difficulty.

By the better character of our cheese, we have created an immense home market which could not have been secured on the old quality of cheese. The great bulk of Herkimer county cheese, as it was made 15 years ago, was soft, slushy, liable to fall in pieces, easily tainted, and not unfrequently alive with skippers.

Could this cheese make such a way in the market as the "factory cheese" of to-day? Could you and I be induced to buy and eat freely a poor and imperfect cheese at any cost? No, no; the people want a good thing, something that is attractive in flavor, and which gives pleasure in the eating. I question whether intelligence and progress ever injured any people. No, my friends, the world moves, and progress has been vouchsafed by a beneficent Creator. In proportion as we become more fully acquainted with the laws and operations of nature, so shall we be more competent to combine our opinions and form correct theories. If by the fan of knowledge you can winnow away the chaff of error, you may thus separate the kernel of truth in a purer form, but we must be guarded lest we lose the precious corn of truth. It has been done before. It is not from knowledge that we need have cause of fear, but rather from ignorance.

The world is full of error. It travels fast and far; it is at war with progress; it seeks to insinuate itself under the garb of truth, in every experiment, and into all our operations. It is the great arch enemy, which must be met at every step and overcome. We are constantly elaborating and copying from what has gone before us, and it sometimes takes ages to find out how foolish men were in remote times. Take for instance the theory that the earth was a plain, and see how many ages passed before it was overturned and a spherical form of the earth established. For many years, and nearly up to the present day, we had a theory in regard to the elaboration and circulation of sap in the trees, and another theory in regard to the origin of heat from the sun. Recent investigations have shown that there was no foundation for these theories, and they have been abandoned by scientists.

The recent researches of the chemist, and the wonderful discoveries made by the use of the microscope, have uprooted and annihilated many things that were once considered positive knowledge well grounded in science. It is now held by scientific men that those dreadful scourges, the cholera, the yellow fever, the black tongue, and the vast range of epidemics which afflict people, and the origin of which has been a puzzle to the medical profession, are due to a species of fungi,—living organisms which prevade the atmosphere from time to time in countless numbers, and are inhaled with the breath, when they enter into the circulation, feed upon the tissues, and poison the blood.

The microscope reveals these organisms, and recent experiments in bottling air and transferring it from the infected district leave no doubt that these organisms can be carried from one place to another, and thus commence at once to multiply and spread disease among those who breathe the air where they have been introduced. Even in the common whooping cough the mucous accumulating in the throat is found to be alive with organisms peculiar to that disease, and that they carry the infection to healthy subjects. The microscope is revealing many curious things, and is overturning theories that were once supposed to be settled beyond question.

The last half century has been more fruitful in the practical application of principles for the betterment of the human race than any previous fifty years of which we have any record.

The application of steam to ocean and land travel, the transmission of intelligence by telegraph, the adaptation of machinery for manufacturing purposes and for farm work, the utilization of various earthy deposits, all have been of infinite advantage in ameliorating the condition of man.

Prof. Wilson has well remarked that our science ministers only to the physical necessities of man. It does not acknowledge his imagination, or directly concern itself with the ascription of beauty to some things and ugliness to others. It does not acknowledge his conscience, or care about right or wrong, or affect any interest in his moral welfare. It does not even pay court to his intellect, or profess sympathy with his cravings after knowledge for its own sake, his impatience of ignorance, and longings for perfection. It knows him only as the paragon of animals, the most helpless though most gifted of them all. It seeks only to meet his fleshy wants; to enlarge the practical empire of his senses; to make his arms stronger, his fingers nimbler, his feet swifter, and, with help from hygienics, his form more stalwart, himself a more smoothly-running, well-ordered, living machine. Putting aside, then, all questions of beauty, morality, or philosophy, we are to consider where man can acquire the knowledge which will give his body the victory in the daily battle of life.

To solve this problem he must fall back upon the sciences which reveal the properties of matter, and the modes of attaining it. Thus, to take a complex but striking example: through observational science we may discover a soil more or less fertile all the world over, but transformational science must show us how to fence and till it, how to drain or irrigate it, or manure it, before it can be made a fruitful field. Geology, striving ever, to reach nearer to the center of the earth, finds coal for us, chemistry teaches us how to cook, *i. e.*, literally to cook this raw material, and how to distil it into naphtha and gas. Mineralogy selects iron ores for us; chemistry converts them into steel; and mechanics forge that into bars. Descriptive botany plucks a wild currant; physiological botany changes it into a sweet grape; chemistry ferments it into wine, and transforms that into ether. Descriptive zoölogy lays its hand on a caterpillar; physiological zoölogy nurses it into a strong silk-worm; chemistry bleaches and dyes the silk while it spins; and mechanics weave it into velvet. People of this age have the means of enjoying more comforts than they did fifty years ago; but that they do not, in many instances, is because they fail to see what is practical, and how to adopt it.

"The history of labor," says Mr. Ball, "ever since the expulsion from the garden of Paradise, is one of the hardships of suffering and of humiliation. The mighty structures that lie scattered along the banks of the Nile, the wonderful ruins that whiten the sands of Asia, the magnificent temples erected to the gods of Athens and of Rome, the huge teocallis of southern and central America, all tell of the ignorance and the helplessness of labor, and its complete subordination to the educated and governing classes of the world. Only here, where the sun of freedom lights up the halls of learning and the chambers of legislation with its heavenly splendor, has labor risen to the true dignity of citizenship, and become a power in the state which it supports and enriches.

Heretofore manual skill and dexterity were sufficient. While invention slept in the arms of ignorance, and discovery stood bound to the portals of the church, while the laborer was satisfied with the clumsy tools, rude dwellings, and coarse fare of a hundred years ago, there was no motive and no need of cultivating the intellect, or invoking the aid of other powers than reside in broad shoulders and strong arms. It was only to repeat to-day the wearisome labor of yesterday, and renew to-morrow the hopeless toil of to-day.

But now the scene is changed. Discovery, no longer the servant of superstition, has explored the deepest recesses of nature, and solved some of its profoundest mysteries. It has explained the composition of the soul, and traced its elements into the plants and trees which adorn its surface. It has shown that animal bodies are built up of precisely the same material that compose the grains and grasses upon which they feed, and it has followed these materials, when liberated by death and decay, back to the earth from whence they were taken; thus demonstrating the great law of nature, which makes a fertile soil necessary to the healthy development and vigorous condition of animal life. It has studied the character and learned the uses of many of the forces of nature, by which it has been able to harness the elements to the car of civilization, and make the invincible powers of earth and air agents of human progress; and, while crowning with immortal bays the brow of learning, it has poured its richest treasures into the lap and around the feet of labor. Society, led by science and the arts, attended by wealth and fashion, makes every day larger demands upon its members, and requires a different life from that our fathers led,—one more in accordance with its past achievements and future expectations,—better houses, richer furniture, handsomer grounds, costlier entertainments, higher personal graces, and broader hospitality. As wealth increases and knowledge becomes diffused among the people, their demands will be diversified and augmented, until everything offensive to taste and Christian morals will be excluded from the land, and society reach its highest state.

You see now the reason and the necessity for the education of labor,—you see now, with whatever degree of success our ancestors drew their support from the soil, we, even by the practice of the same prudence, industry, and economy, can arrive at no such result, partly because advancing civilization has multiplied our wants and increased our duties, but principally for the reason that in our attempts to subdue the earth and exercise dominion over it, learning is a weapon which gives to its possessor an advantage for which no amount of industry, no degree of economy, and no power of bodily endurance can compensate, and hence the impossibility of successful competition for the rewards of agricultural industry while the farmer remains ignorant of those discoveries in science and inventions in the arts, which have revolutionized labor, and made brain superior to muscle. The dairyman and cheese manufacturer must now bring to his occupation an amount of knowledge altogether beyond what has hitherto been deemed sufficient, and I know of no way by which this knowledge may be made to strike so deeply and so rapidly into the minds of the masses as by the instrumentality of associations and conventions like this, where neighbor can meet neighbor, and discuss improvements, and correct errors.

Many farmers think it entirely sufficient to study nature and copy her processes. These men hold fast to the traditions of their fathers, and rejoice in following a system that is independent of science and the arts, but they forget that nature never reared a Flying Childers, a Flora Temple, nor a Dexter; no lordly Durhams nor sleek Devons roam her forests, no Leicesters nor South-Downs feed in her pastures, no golden cereals ripen on her prairies, no melting fruits load her orchards. But the yellow maize waves its leafy banners, and the tall wheat bends its imperial head in graceful homage to the intelligent husbandman, who by a new creation has added these products to the means of human existence.

The trees of the orchard and garden reach out their perfumed branches and drop their purple treasures into the lap of the successful cultivator, whose art has conquered nature and crowned the hill-tops with golden fruitage.

So in the cheese-making art, the dairyman who stands idle, following old traditions, will soon find that his product is not wanted in the markets of the world. If Michigan hopes to retain her prestige and keep pace with the advance civilization of the age, it must be done through the efforts of agriculturists and agricultural associations, where the best men shall be drawn together for discussion, and where the experience of the best farmers shall be exchanged,— men who can warm into honest enthusiasm concerning the capabilities of your farms, instead of belittling and bemoaning home and glorifying other lands. Here your statesman, your editors, your eminent professional men, should meet and indicate by their presence and counsel that they have an interest in the welfare of this State; that they have faith in her resources; that her fertile soil, her healthful climate, her established institutions of learning, and her sweet and nutritious pastures, still hold out inducements for the rising population to make a home and competence for themselves in her charming valleys and upon her verdant plains.

When Jesse Williams, the unpretending farmer of Rome, in 1850 conceived the idea of associated dairies, it was forced upon him as a necessary means for accommodating members of his own family. He had not the remotest idea that he had hit upon a great principle, that was of wide application, and which was destined in all coming time to be the means of lifting heavy burthens from the arms of toil. But aside from the burthens of toil and the drudgery from which this system operates, to relieve our farmers, it has developed another great economic principle,—the means of producing food cheaply,—a principle which the Creator, in His infinite wisdom, it seems to me, is now impressing upon the minds of people, by the establishment and wide spread dissemination of this system. The question of food, in all densely populated countries, is one that underlies all others. No nation can rise to the highest civilization and power without her people are supplied with an abundance of cheap and nutritious food. Where food is scarce, or wanting in nutrition, there you will find poverty, squalid wretchedness, demoralization and crime; elements of weakness opposed to progress and civilization. Food nourishes not only the body but the brain, and the cheapness and abundance of good food has had much to do in the rapid progress and active development of mind among the American people. But the population of the United States is increasing with wonderful rapidity, and already the supply of meats is becoming comparatively scarce. They are to-day at a price that poor people have a difficulty in obtaining them; and as our population increases there will be a still further scarcity of meats for the supply of our people. Some other form of animal food must be substituted for beef, and the question is becoming every year more and more urgent, how can it be produced cheaply; and in my opinion we must look to the dairy as the chief means of solving this difficulty. I can illustrate this more satisfactorily, perhaps, by showing the comparison between the relative cost of producing beef and cheese. A steer which will weigh 1,500 lbs. at four years, must be a good animal, and will yield, say 1,000 lbs. of meat. Three steers, on the above assumption, would produce 3,000 lbs. of beef. Now a good cow will yield from 500 to 600 lbs. of cheese per year, say 450 lbs. per year, and deducting the first two years in which, as a heifer, she yields nothing, we have 4,500 lbs. of good animal food. In other words these steers, at four years old, representing twelve years growth of beef, amount to 3,000 lbs., while one cow, twelve years, for cheese, represents 4,500 lbs. But a pound of cheese is equal in nutrition to two pounds of beef, which would make the difference still greater, giving for the dairy 9,000 lbs. of food on the one hand, against 3,000 lbs. of meat on the other. Then there is the cost of cooking to be charged against the beef, which, as you will see, adds further to the expense of that kind of food. Who shall say that in the mysterious workings of Providence the establishment and spread of the factory system has not been for some wise purpose, more beneficent than that which has been commonly assigned to it, and that in coming time millions of people are to draw their supplies of annual food from this source.

In regard to milk as an article of food, Dr. O. C. Wiggins, inspector of milk in Providence, says the nutritive value of milk, as compared with other kinds of animal food, is not generally appreciated. There is less difference between the economic value of milk and beef steak, or eggs, than is generally supposed. The quantity of water in a good quality of milk is 86 per cent. In a round steak 75 per cent. In fatter beef 60 per cent. In eggs about 68 per cent. From several analyses made last winter he goes on to say: "I estimate sirloin steak (reckoning loss from bone), at 35 cents a pound, as dear as milk at 24 cents a quart; round steak, at 20 cents a pound as dear as milk at 13 cents a quart, and eggs, at 30 cents a dozen, as dear as milk at 20 cents a quart."

Many laborers who pay 17 cents a pound for corned beef would consider themselves hardly able to pay 10 cents a quart for milk, when, in fact, they could as well afford to pay 15 cents. Milk is a most wholesome and economical food for either rich or poor, and it ought to be more largely used. If the money expended for veal or pork were expended for milk, I doubt not it would be an advantage both to the stomach and pocket, especially during the warm season.

Relatively speaking, then, milk is the cheapest animal food that can be used. Whether farmers can afford to produce it cheaply is a matter for them to decide. It is very probable that were they to ask a very high price, a very large number of our people would refrain from its use, from mistaken notions of economy, notwithstanding they might be excessive meat-eaters.

But it has been urged that there is likely to be an over-production of diary products, and therefore it must be unsafe to continue the business of dairying. It is now twenty years since this prediction was made, and yet we come no nearer its fulfillment to-day, it would seem, than when it was first assumed. We are producing in the United States 700,000,000 lbs. of butter, and 250,000,000 lbs. of cheese per year. The butter is nearly all consumed among our people, or, at least, there is but little for us to export. We send abroad annually about 60,000,000 pounds of cheese, but the time is coming, in my opinion, when all our cheese will be needed for home consumption. Our annual consumption, of late years, has increased at the rate of 13,000,000 lbs. per year, and that there is still a margin may be seen from the following estimate:

Our population is now about 40,000,000. Say that each individual should take only one ounce of cheese per day, or a third of an ounce at each meal, simply as a corrective of other food. Now, this same quantity distributed among our 40,000,000 of inhabitants would make an annual consumption in the United States of 910,000,000 of pounds, which is 660,000,000 of pounds more than we are producing. But, suppose we deduct 10,000,000 of inhabitants as non-consumers, and allow half an ounce per day for the thirty million of people, and we have an annual consumption of cheese amounting to 342,000,000 of pounds, which is still about 100,000,000 of pounds more than the whole country produces. The fact that cheese is a wholesome, nutritious, and economical article of food, and one of the cheapest luxuries of the table, must, it would seem, bring it largely into use.

But, you will ask, what are the living vital questions of the day in dairy management, and what can this association do to bring about the most desirable results in manufacture?

Until quite recently, neither the dairy farmer nor the cheese manufacturer has fully understood the causes of milk taints, or the influence of ferments upon the products manufactured. The cheese-maker, groping along in the dark, has employed certain agents and manipulations to bring about a desired result. From the experience of others, or from his own practice, he has fixed upon a set of rules, which, with good material, and under favorable circumstances, have accomplished the object sought,—the turning out of a good product. But, if the material happen to be faulty, and the circumstances unfavorable, he fails of success, though operating under the same rules. Again, he has learned that faulty milk, under certain manipulations, need not be lost altogether; but may be turned into a second-class product.

For several years past the great effort of manufacturers has been to devise means for making a good product out of bad material.

Of course much has been learned from these experiments, concerning the treatment of bad milk and floating curds, but at what a fearful cost? And the result gained is, that, although faulty milk may be turned into an inferior or second-class product, no skill has yet been able to convert it into the best goods. Had we known precisely the nature of the causes affecting milk, and had the energies and unceasing exertions of manufacturers been turned to the prime causes of their troubles and the correction of faults at the fountain head, the great bulk of American cheese, to-day, would have been of superior excellence, quite beyond anything yet produced.

Suppose a woolen manufacturer, skilled in the machinery and running operations of his factory, but with no knowledge as to the qualities of wool, should attempt to make superfine broadcloth from the coarse, almost worthless, tags taken at the factory. He finds it does not work satisfactorily, and cannot be made into fine goods.

Supposing, then, that he attempts to alter his machinery and adapt himself to the situation, would you say that this man is adopting the best plan for success? Would it not have been better to have studied the character of the raw material,—to have selected his wool in reference to the quality of goods he was seeking to make, since no amount of ingenuity and effort on his part will enable him to manufacture superfine cloth from coarse, refuse material? He may learn some useful lessons in the management of this kind of wool, and perhaps the goods may be sold in market at a low price, sometimes covering the cost of production, and sometimes not.

Well, the manufacture of American cheese has been carried on somewhat upon this principle. Milk is brought to the factory, and the manufacturer cannot tell what is the trouble with it. He soon finds it will not work up into first-class goods, and so he does the best he can to save it from loss, turning it into as good a product as he knows how.

It is now known that milk is changed from its normal condition by fungi,—living organisms that take possession of the fluid, and by their growth and multiplication bring about the various phases of coagulation, and the breaking down of the lumps of curd upon the shelf, until it assumes a mellow, flakey condition, fitted in flavor and texture for the human stomach. Certain germs or spores of fungi are supposed to be natural to all healthy milk, while the same character of germs also pervade the atmosphere, and these last, falling upon the milk, are absorbed in it, where they multiply and grow, and thus the milk curdles and turns sour, developing what we call lactic acid fermentation. The rennet is supposed to contain an immense number of spores, and its effect in curdling milk is attributed to the living organisms which, by their multiplication in the milk, cause curdling, or coagulation of the fluid. They go also into the cheese upon the shelf, and, under favorable temperatures, they perform the important office of breaking down the caseine, and converting the cheese into a mellow, delicate morsel of food. Now so far as *these fungi* are concerned, they are the cheese-maker's real friends, and under favorable conditions as to temperature, time, and place, they may be controlled to do the cheese-maker's bidding. But it is altogether different with those fungi which have their origin in putrid animal matter, or in filthy vegetable composition. Their influence is altogether harmful, and it is from these organisms, which get possession of the milk, or the cheese upon the shelf, that nearly all the trouble comes in prosecuting the cheese making art.

We now have positive knowledge that milk is tainted in the cow's bag, before it is drawn, on account of the cow's inhaling the odor of putrifying animal matter, such as that coming from deaconed calves, dead horses and the like, left exposed to decay in the open air; that the filth from vegetable decomposition adhering to the udder and hair of cows, while passing through swales and slough-holes, becoming detached while milking, and falling into the milk, even though in minute quantities, spoils the milk, and unfits it for manufacture into a good product; that filthy stagnant pools are filled with living organisms, and the animals drinking from these pools take them into the system, when they are carried into the circulation and are secreted in the milk, tainting it and producing the same character of filth as that from which they emanated. These facts have become fully established by the microscopic investigations of scientists, and it is for the dairymen of America to meet the situation squarely and devise means to obviate the difficulties. Is it not a waste of time and money to be longer dilly-dallying over the cheese vats, trying to devise means to get a good thing out of bad milk, when the trouble would be obviated by having a good material in the first instance?

The more important point, it seems to me, is to educate the farmer and hold him responsible for the production of good milk. This work, sooner or later, must be done, and I am fully persuaded, should the dairy associations turn their attention *to this one point* and resolve upon a system of reformation among farmers in the production and delivery of milk, American cheese would at once begin to rise in excellence, and make rapid progress towards perfection. I know of but one man upon this continent who has fully comprehended this question in all its bearings, and applied the remedy upon an extensive scale.

That man is Gail Borden, the distinguished inventor of the process for condensing milk *in vacuo.* He has several factories operating in this business, where a large quantity of milk is daily delivered.

I recently paid a visit to Mr. Borden at his home in White Plains, and examined his extensive milk condensing factory at Brewster. Mr. Borden has made milk a minute study for the last 25 years, and probably there is no man living who has given so much attention to the practical handling of milk upon a large scale, and to the causes influencing its flavor and goodness, as he.

You will understand that Mr. Borden has originated and developed an immense business, and has been able to put upon the markets of the world a milk that is now acknowledged by consumers to be purer, better flavored, and altogether more healthful, than it is possible to obtain from the city milkmen.

Consumers who have used his "Eagle Brand" of milk for years tell me they have never opened a poor can, and have never been disappointed in its flavor and quality.

Now, as it is more difficult to preserve the flavor of milk for long periods than it is to preserve cheese, and as consumers notice imperfections in milk sooner than they do in cheese, you will ask,—how has this result been accomplished? I asked Mr. Borden this question. I asked him how much milk received at his factory he allowed as waste, on account of its being out of flavor and imperfect, and he told me not a gallon was lost on this account; that in fact no bad milk was now received at the Brewster factory. He told me that in his early experiments he made many failures; that he had tried to convert bad milk into good, as you cheese-makers try, but that no ingenuity or device had yet been able to overcome the difficulty, nor did he believe it could be overcome by any process of handling, for sooner or later its imperfections would make their appearance in the produce manufactured.

He said his success in making a good article of milk depended not so much upon the formula in the best specifications as upon the condition of the milk brought to the factory, and the care and attention given to every part of the process, of the washing of the vessels, and the thorough cleanliness which should be observed in every department.

"The success of the milk manufactured at our three factories known as the 'Gail Borden Eagle Brand,'" he said, "is due to the attention which we give to the personal inspection of every department of the dairies on our farms, which is assigned to one person at each factory; the constant examination of every man's milk by samples taken and subjected to tests as to cream, sweetness, and the time it will keep after being brought from the dairy. In short, there is nothing manufactured requiring so much care and everlasting vigilance and attention as that of milk."

Now, Mr. Borden began in the first place at the farm.

His milk must come from upland pastures or well drained soils. The animals must not be allowed to wallow in swamps and mud holes. They must be provided with clear running water, or good water pumped from wells. Attention must be given to the food the cows eat, and nothing is allowed in the pastures or food that taints the milk. No milk is received from cows that have not calved at least twelve days (unless by consent of the superintendent). The cows must be milked in clean stables, and not allowed to pass through accumulations of manure at the entrance of the stables, or in the yards. The milk must be drawn in the most cleanly manner, and strained through wire-cloth strainers. It must be cooled in a bath of cold water to below 58 degrees, and the water must be sufficient to reduce the milk to that temperature in 45 minutes. Cows in heat must be separated from the rest of the herd, and kept quiet during its continuance. Dogging or fast driving of cows is not allowed. A sample of every man's milk is taken daily at the factory, and tested in regard to the standard of lactometer, temperature, cream, and time it will keep. A record is also kept, opposite to each patron's name, of the amounts of milk rejected, and the cause of rejection, with such other remarks as the case requires. The inspector visits every man's farm at least once during the month, and oftener if the register shows any variation from a certain standard.

In this way Mr. Borden has educated his patrons, until he affirms no losses are sustained on account of bad milk.

Now, my friends, I ask you if this is not the most practical and common sense method to be adopted? It has been found to produce the highest results and greatest profits in Mr. Borden's factories, while the farmers themselves have reaped more money by far than their neighbors following the old careless system of producing faulty *rotten milk*, while at the same time are more intelligent and happier from the consciousness of well doing.

Oh, my friends, I feel an earnest desire for the success of dairying everywhere upon this continent, and I am fully convinced we shall never rise to the highest excellence in this branch of industry, until this work of education begins to take root and become developed upon the farmer.

I would urge this matter of producing milk as most vital to your success. Let every factory assemble its patrons together. Let there be a full understanding and agreement among all concerned. Let an inspector of milk be appointed, clothed with authority to visit farms. Let the rules adopted be rigidly enforced. Do not make any half-way work about it, but proceed with the determination that nothing short of gilt-edged cheese is to be manufactured. That point is within your reach at once. Where water is not abundant on the farm, introduce the system among farmers of aerating and cooling the milk by means of the recent invention for the purpose, which consists of forcing the air by means of a common bellows, through a pipe to the bottom of the can. It is a simple, cheap, and efficient appliance. In this way you at once strike ahead of the best dairy practice, and, with attention to curing cheese upon the shelf, will be able to compete with the finest goods in the world.

The extreme fine flavor and quality of the high-priced fancy Cheddars of England is due to five points, namely: perfect milk, drawing the whey early from the curds, a slow development of acidity in the curds exposed to the air, a thorough expulsion of whey, and a uniform temperature of 70° in curing the cheese upon the shelf.

I speak from no theoretical standpoint, but actual observation, and the handling of the curds in the best Cheddar dairies in England.

CURING CHEESE.

The second great question for the attention of American dairymen of to-day, is the proper curing of cheese upon the shelf. The subject has been entirely ignored by our dairy associations, and by the dairymen of America.

The curing of cheese has as much to do in securing fine flavor and quality as the manipulation of the milk and curd. Immense sums are thrown away annually in the best dairy regions in New York, simply on account of imperfect curing-rooms. I do not know of a single "Gilt-edged factory" in the State but that has lost, during the past three years, more money on account of damaged cheese caused by imperfect curing-rooms, than would have paid the whole cost of a large and properly-constructed "dry house." I doubt whether there is a curing house upon the continent where ventilation and uniform temperature can be controlled or maintained. A well-made cheese, when removed from the press to the cheese-room, contains a certain amount of moisture, a part of which must pass off in the ripening process, or the cheese will not acquire good flavor. If the cheese is kept in a damp or badly ventilated place, the excessive moisture will develop another class of fungi, a different kind of fermentation than that required for good cheese. From experiments made it has been found that 2,000 pounds of *newly-made* cheese will give out nearly two pounds of moisture during 24 hours, and the sooner the room is cleared of such moisture the better; for if it is condensed and falls back upon the older cheese, or if the cheese is constantly saturated with these exhalations, it will injure the flavor.

We turn newly made cheese daily in order that the moisture may readily pass off, and the fermentation of the cheese be carried along in a uniform manner. Ample ventilation then is important,—ventilation that shall carry off these fumes of decay and cheesy exhalations. From a large number of well conducted experiments the principle has been established that a temperature of about 70° is the best for curing well-made cheese, to secure fine flavor and rich mellow texture, as well as long-keeping qualities. The growth of fungi in fermentation must be slow and uniform. You may force it forward by high heat and light salting, but always at the expense of long keeping qualities.

The system of preparing cheese for market at *twenty days old* is a most pernicious system, and is the source of fearful losses to American dairymen every year. It is admissible only when you know where to place your goods, and that they are to go into immediate consumption. In 1866, while in England, I saw the result of such manufacture in numerous instances; cheese that came in good condition, and if sold at once would command 76*s*., in a week's time so fell off in flavor that it went begging at 50*s*.

I know that American dairymen and American dealers often boast of our system, because we can make cheese that is so soon ready for market that the shelves can be cleaned from month to month; but they do not couple it with the fact that much of our cheese sells in England for 30*s*. to 40*s*. per cwt., and even less. Some one loses on these goods, for no cheese of good flavor, that can be held, would be sold at such a fearful loss. I think the American method of curing cheese is grossly defective, and it is upon this point that we need the application of science, and the genius of inventors.

It will not do to take the chances of the weather in a climate so variable as ours. Our intensely hot summers must be counteracted in some way in the curing house, and, if we really set about it, we can overcome the difficulty, and the time when this should be done is *now right upon us*. I believe that a good many old curing-houses could be improved by building around on the inside wall, leaving six or eight inches space between it and the present wall, and by arranging double windows. It has been suggested that saw-dust or some non-conducting substance, be placed between the walls. I saw something of this kind last winter in Ohio. It was a store-house for keeping late-made cheese, after it was cured, during the winter. Messrs. Howe & Warner, at Wellington, have a store-house of this description, where, on the 24th of January, 1872, they had over 10,000 cheeses stored in boxes, and, though the weather had been intensely cold, no trouble was had from frost.

I am inclined to think that the plan of dry or well ventilated cellars or basements could be adopted, so that a low, even temperature in hot weather may be secured at little expense and trouble. I would have such basement under the whole dry-house, at least six or eight feet below the surface of the ground. The walls should rise above the ground three or four feet, so as to give an abundance of sunlight throughout the whole. I would have the rooms ten or twelve feet high in the clear, and the bottom should be thoroughly underdrained. Then, the floor should be grouted and covered with cement or flagging so that no water could enter from without, or the accumulation of slops be possible. Ventilators with wickets should be arranged leading to the roof. The trouble with under-ground structures or basements as curing-rooms is, that often no attention is paid to drainage or ventilation, and hence, in such cases, they make very imperfect curing-rooms. But on the plan I have proposed, these objections would be obviated. Then, if necessary, waste water from the ice house may be conducted in metal pipes along the ceiling, and the cool air falling from these would preserve a low temperature in the room.

Mechanics with whom I have consulted affirm that cold spring water, flowing in large metal pipes along the ceiling, and then out of the building, where it may be utilized for other purposes, would be sufficient to reduce the temperature to 70° or below, even in the hottest weather. Hot-water pipes, arranged about the room and connected with the boiler, would be the best means of raising the temperature in cool weather, when heat was required. I do not pretend to give the best plans, but I offer suggestions by which the hot weather cheese may be kept in flavor until fall, or such time as it may be sold, at not much expense in the way of curing-rooms.

I wish I could convince you of the great importance of having properly constructed curing-rooms, where good ventilation and a low even temperature may be maintained. And

I speak to you from no mere theoretical standpoint, but from well-conducted experiments in my own daily practice. Some years ago I built a farm dairy-house with curing-room in the second story. Even with the floor, on two sides of this room, were openings through the sides of the building,—five on a side,—provided with wickets, so as to regulate the quantity of air to be admitted as desired.

In the center of the room was a large ventilator running from the ceiling up above the roof of the building, also provided with a wicket for regulating the air. Here I experimented from time to time in the curing of cheese, and I found even with this arrangement that a temperature not above 75° could be maintained in the hottest weather, by regulating the wickets and by the use of water upon the floor, which by its rapid evaporation would reduce the heat as desired. By attending to this matter I found that cheese could be preserved in good flavor throughout the season, when the factories and farm dairies about were not able to keep it; and my experiments have convinced me that any temperature above 75° could not be safely allowed for curing cheese, and that with proper attention to temperature, well-made cheese could be cured so as to retain a mild, sweet, nutty flavor for a long period. In my examination of English cheese in 1866, I tasted of samples from one to two years old in which this mild clean flavor had been retained to perfection, and Mr. Harding and others assured me that the preservation of flavor was on account of the curing.

When cheese is properly cured in an even temperature of 70° and breaks down mellow and flakey, it is not so liable to lose flavor afterward, though exposed to higher heat. The great damage from heat seems to result during the first 40 days. In other words, two cheeses from the same vat, the one kept at 70° for 40 days and the other at 90°, and both then subjected to high heat, the first will retain its flavor a much longer time than the other.

MARKETING AND MARKET FAIRS.

Now the knowledge and practice of a good system of dairy farming is very essential to success. To know how to manufacture good butter and good cheese, and to properly cure and pack it, is also of prime importance. But there is something beyond all this which not unfrequently depresses and paralyzes all our best endeavors in dairy management. I refer to a loose and unskillful manner of marketing dairy products. It is quite needless for me to say to you that no farmer, no produce dealer, no business man can conduct operations with success when his necessary expenditures are greater than the receipts. Well directed labor in any department of industry should have an adequate reward, and that it fails to accomplish this end is the result often of some lack of foresight, and consequent mismanagement, on the part of the operator.

The exports of cheese from the United States to Great Britain during the year 1871 were the largest ever made. According to official returns from the custom house, they amounted to 68,732,520 pounds from January, 1871, to January, 1872, or about 12,000,000 pounds more than the previous year. The make of cheese in Canada is estimated to be from ten to fifteen millions of pounds, and the exports are supposed to be eight or nine millions of pounds; if we call it nine millions, the exports of cheese from America to Great Britain during 1871 were about seventy-seven millions of pounds. I can give you the amount of money which Great Britain has paid the United States for cheese, shipped for the years ending July 1st, 1869–70, and July 1st, 1870–71. In 1869–70 England paid us $8,881,934 for 57,000,000 pounds of cheese. In 1870–71, $8,752,990 for nearly 64,000,000 pounds, or about the same amount of money for seven millions more pounds of cheese. If the amounts were compared from January to January, a much greater difference would be shown, because prices from July, 1871, to December 31, 1871, were much lower than in 1870.

The shipments from the United States in the year 1871 were: in July, 12,424,565 lbs.; in August, 11,552,496 lbs.; in September, 10,095,725 lbs.; showing that the half of our exports was in hot weather. You need not be told that the average price of cheese that year (1871) was low. True, there were several circumstances that conspired to bring about a weak state of the market, such as the general decline in the price of all farm products, especially the low rates of bacon and pork; but the chief cause of low prices was the stupid manner in which our cheese is cured, brought forward, and forced upon the markets in hot weather. There is scarcely a factory within my knowledge in New York that is provided with room sufficient to keep the hot-weather cheese. The factories push forward immense quantities of cheese in July and August, not only from the fear that it will lose flavor at the factory, but because there is no room to hold it.

The local dealer who buys is in a hurry to be rid of it, for fear of losses in hot weather. The shipper is also afraid of it, for the same reason; and every one who handles cheese in hot weather is in hot haste to shift responsibility and risk upon some other shoulders than his own. I cannot see how it is possible to sustain high prices under such a condition of things. It is a forced sale from beginning to end, and the law of forced sales is that real values cannot be realized.

The remedy, it is obvious, lies in additional curing-houses at the factory, so constructed that cheese may be held in good order from time to time as desired, and without fear of deterioration or loss of flavor.

It is believed by many that dairymen are to get relief by the abandonment of dairying in some other localities than their own. Thus, dairymen at the east talk of getting relief by the abandonment of dairying at the west, thereby reducing the general make of cheese. I do not think we can look for any permanent benefit in this direction. The business will be developed from year to year in new localities where lands are adapted to the dairy. You cannot convince Illinois or Wisconsin that more money is to be made in pork or grain raising than at dairying at present prices, because the facts are against any such assumption. The cost of transportation eats out the profit of grain-raising at the west.

The cheese makers of Illinois are altogether better off this year than the grain raisers of that State, and so of Wisconsin and other States. We are not over-producing in dairy goods, —that is not the matter,—but we lack enterprise in opening *home markets,* and in supplying the kinds and qualities of cheese desired by our people.

And then again, we persist in curing cheese so that it will not retain flavor, and forcing forward our goods when there is most risk in handling, and when they cannot be taken except at a heavy margin to cover prospective losses. The fact has become notorious that America furnishes no really fine old cheese. There is a demand for good old cheese at high prices, but it cannot be had, at least at the East, at any price.

The Eastern system of picking out all the best goods for export, is a vicious system, because it checks home consumption, which should be promoted by every means possible. There are hundreds of villages in the United States where it is impossible to get a pound of good cheese from one year's end to the other, and many people who are naturally lovers of good cheese cannot understand why it is not offered for sale.

ADVANTAGE OF CENTRAL MARKETS.

It has been abundantly proved wherever the experiment has been tried, that an organized system of marketing is not only a benefit to the producer, but to the produce dealer. When goods are scattered over the country it requires immense labor on the part of dealers to hunt them up, and get supplies together. It is also quite expensive, not only taking time which is valuable, but necessitating an outlay for horse-hire and other traveling expenses, which in the aggregate during a season, amount to a very large sum, all of which the dealer must either lose from his legitimate profits, or take out of the farmer's earnings by purchasing at so much below the actual market value of the article for sale. Suppose a farmer has five tubs of butter, or a few hundred pounds of cheese, ready for market. The dealer makes a journey to the premises and buys the goods. His time is very much more valuable than that of the farmer's, and the actual expense of the journey (say $10 or perhaps more) must be met somewhere. Neither the farmer nor the dealer can afford to lose this sum. It is a waste of time, and a useless expenditure of money, resulting from a wrong system of marketing; for if producer and dealer agree to meet on a certain day at some convenient market point, a large amount of goods can be examined in a brief time, and at a minimum expense. But this is not the only advantage. There is a constant change going on in the great markets of the world. The price may be up this week and down the next. When goods are scattered over the country in separate lots it takes too much time to gather them together, and hence the dealer must run larger risks, or must make a liberal margin on his prices to cover any prospective loss on account of the delay in getting to the city to meet present demands and present prices. If the dealer can meet the producer at the railroad depot, and purchase his goods and ship them at once, he knows to a certainty when they will arrive at their destination, and thus he reduces his risks.

And it is very important to the farmer that these risks be reduced to the lowest possible point, for heavy losses on the part of the dealer always react on the producer, making dull markets and depression in business. It is right and proper that dealers be paid liberally for their services, for the risk of their capital, and for their skill in handling produce; and what we seek by a central market is, not to deprive them of their just compensation, but to cut off useless expenses, and make business more safe and profitable to both parties.

Again, a central market stimulates to better production and more permanent improvement. There is many a farmer and factory man who has no adequate idea of the relative quality of his goods, until they are set side by side with those that are better, and where they can be fully tested and compared.

At a central market you meet with numerous experts, and the judgment of different persons gives more satisfaction and greater weight than that of one person, whose opinion is often suspected of being warped or biased, perhaps for private ends.

Then, at a regular central market there is always a community of interests, a spread of intelligence not only as to market values, but as to production and manufacture, which is of very great importance to the producer's interest.

I have endeavored to shadow forth some of the more salient advantages that result from the establishment of country markets,—markets which ought to be inaugurated at least in every dairy section in the country.

The plan has long existed in England, and I was very forcibly impressed with its great practical benefit during my visit to Great Britain in 1866.

In England convenient buildings and grounds are provided, where all kinds of farm products are collected for sale on market days. Farmers find these markets of the utmost advantage, whether they be sellers or buyers. If one wants to buy a horse, a cow, a pig, or any other farm product, he goes to the nearest market, where are collected a variety of these animals, and which are offered at different prices.

Hence, farmers themselves who are purchasers find the markets economical, because the expense of traveling over the country to look up the article desired is saved, while at the same time those who have goods to sell, have an opportunity of meeting persons who desire to purchase, and thus they readily dispose of stock or goods that would, perhaps, depreciate on their hands awaiting a customer. Nothing strikes an American in England with more force than the fact that an English farmer can pay such enormous rents for land, and yet save something by farming. The English consumer pays, for the most part, but little more than the consumer here. Indeed, the cost of living is cheaper in England than in America, and yet the farmers, on an average, get more for their produce than the farmers in America. How is this to be accounted for, except it be that they have a better system of marketing, by which the consumer is brought nearer the producer, and a great many useless expenditures and risks to the dealer are cut off, than by our system, which is more expensive and speculative in its character?

At the English cheese markets the cheese from the surrounding neighborhoods is brought into the market-place, and piled in parcels under an open shed-like building, and here the cheese-mongers from all parts of the country (or their agents) assemble and purchase such goods as are most desirable, while the different interests of dealers and the strong competition of the trade regulates the price, and prevents any of those losses that follow from selling below market rates on account of lack of intelligence or a healthy competition. The advantage of a healthy competition among buyers who know just where to place their goods has a very marked influence upon sales and prices. I have known goods to sell at the Little Falls market late in the day, and after the leading dealers had left the market, at full one cent per pound below the earlier sales. Why? Not because the goods were worth less money, but because the dealers present had made up their supplies and were not certain where to place a surplus. This is a natural law of trade;—the risks are increased, and consequently a larger margin must be exacted.

AN ADDRESS

DELIVERED BEFORE THE ARMADA FARMERS' AND MECHANICS' CLUB, AT THE SECOND ANNUAL FAIR, OCTOBER 17, 1872.

BY THE REV. R. G. BAIRD OF ARMADA.

Mr. President, Ladies, and Fellow-Citizens:

In compliance with the request of your Executive Committee, I am here to deliver a brief address on this, the occasion of our second Annual Agricultural Fair. This has been a busy day with many of you, and I know that after I get through your feet have to take a good many steps, and your hands have a good many articles to remove, and your heads will be troubled with a good many little perplexities, before they lie down to rest for the night. So get into as comfortable a position as possible, and I will try to make these few minutes of withdrawal from muscular activity as little of a weariness and as much of a refreshment as I can.

And first of all, allow me to congratulate you on the success of your fair,—a success which has gone quite in advance of the most sanguine hopes that had been entertained regarding it. I can well remember with what fear and trembling the members of the Farmers' and Mechanics' Club set on foot, a year ago, the project of holding a fair. They succeeded, however, quite beyond their expectations, and so this year they thought they would try again. The railway company kindly offered the use of their grounds and buildings; circulars were printed and distributed, and it was soon evident that a very general interest was being taken in the fair, for I learned about a week ago that the entries then made were considerably more than the whole number of entries last year. And here let me say a word in regard to the objects which the Association has especially in view in making an annual fair, for I am quite certain that these objects must commend themselves to every one who is really interested in the progress of Agriculture, and I presume there are none here to-day who are not.

For a number of years past, it has been very evident that the interest of the farmers of this vicinity in the regular county fair has been steadily on the decline. I am pretty well convinced that it is so also in other parts of the country. Ask the farmers around what is the reason of this. I have asked a good many, and get substantially the same answer from all. It is something like this: "Why, there is no encouragement to take anything to the county fair, unless it be a fast horse." The money that is realized from entries and admission fees is drawn largely from the farmers, but all the large premiums are carried off by men who come dashing in on the last day of the fair with their fast horses,—a class of men who are seldom found among farmers, and most of whom are doing absolutely nothing for the improvement of agriculture, not even for the improvement of the horse;—while the farmer who comes with specimens of improved stock or grain or vegetables hardly gets premium enough to cover the expense of bringing his stock or produce to the fair, the man with the fast horse walks off with more than ten times the amount.

I do not wish to be understood as finding fault, especially with the Macomb County Agricultural Society, for I do not think it is any worse in this respect than many others. I allude to it as a specimen of what is far too general all over the country.

Now, the argument by which this condition of things is defended is simply this: The managers of these fairs say that it is impossible to make them pay without horse-racing. The horse-racing brings out the big crowd; the big crowd puts the money into the treasury; and the big premium is necessary to bring out the best horses. That is the logic of the whole thing. Many of the directors of the agricultural societies deplore this condition of things as heartily as we do; but they consider it a necessity to the financial success of the fair. They look upon it as being what the miserable old churl called his wife,—"a necessary evil." Now, the members of this society believe that an annual fair can be held solely in the interest of the agricultural and other industrial classes of the community. This is the basis on which they have started out; and when we have got the thing sufficiently established, so that a charge can be made for entries and admission, the funds thus realized will all go back into the pockets of exhibitors, to each in proportion as he can succeed in presenting specimens that shall be deemed by the committee worthy of being awarded premiums. The same inducements will be held out for parties to exhibit the best draught and carriage horses as for other kinds of stock, but no premiums for racing or trotting, as we want an industrial fair, and not a concern that will be captured by jockeys.

No one has requested me to state these things;—I have done it on my own responsibility, because I want you to understand them, so that when the association commences the work (which I expect they will soon) of soliciting subscriptions of stock for the purchase of grounds and the erection of suitable buildings, I want them to meet with a generous response from you whose interests it is designed to promote.

I may also state that the idea is entertained by some of the membersof the association, that besides the exhibition proper, it may become an established usage in connection with the fair, that it be a day for the purchase and sale of stock and all kinds of farm produce. Our friend Mr. Johnstone, of the Michigan Farmer, who delivered the address a year ago, seemed to think this idea rather impracticable. While ready to concede to Mr. Johnstone a more than ordinary share of intelligence in regard to such matters, I still differ with him in regard to this. I think it can be made a success as a day of bargain and sale; but it will require some work to be done specially in that direction. The grounds and accommodations for stock will require to be more extensive than would otherwise be necessary. A committee would want to take this feature of the fair specially in hand, put themselves in correspondence with buyers in different parts of the country, ascertain what buyers would come, and let it be advertised in connection with the fair, and then I think that a good deal will be brought there for the purpose of being sold; and I think both buyers and sellers would find it much to their advantage to avail themselves of the opportunity thus afforded them. I suppose in an address delivered on such occasion as this it is expected that something should be said about farming. My modesty, however will not permit me to suppose that you expect me, who am not a farmer, to instruct you in modes of agriculture, who have spent a large portion of your lives in the actual work of farming. Still, like our friend Horace Greeley, I have some ideas about farming. And now I propose to tell you what I know about it. As I am accustomed to having a firstly and secondly, and sometimes a thirdly in my discourses, you will pardon me if I indulge that clerical weakness to-day. And,

First, I know enough about farming to know that many farmers do not know as much about it as they ought to know.

Some may be ready to say: What is there about farming that every body does not know? Farming is an occupation as old as the human race, and during all this time more people have been employed in it than in any other branch of human industry that can be mentioned. Then, after a man has spent most of his life in farming, it seems like being a little rude to tell him that he doesn't understand his business. I taught school once, and I had a number of pupils that were so defective in nothing as they were in reading. They were miserable readers, but do you suppose I could make them believe that? Not a bit of it. They were so perfectly sure that they knew how to read they would study everything but their reading lesson. Now, it is a good deal so about farming; almost everybody thinks he knows enough to be a farmer. You may tell a man that he does not know enough to work at a particular trade, or to be a lawyer, or a physician, but do not tell him that he does not know enough to be a farmer, unless you are willing to incur his everlasting displeasure. And yet, I think it cannot be disputed that there is not one farmer in ten who makes his farming as remunerative as it might be, and considerably less than one-half of those engaged in it realize any real profit at all.

I presume that this township will compare favorably with most townships in regard to the intelligence and industry of its population; and yet, I venture to assert that not one acre in three of the land cultivated in this township yields any margin of profit to the farmer. I took the census of this district two years ago, and I know whereof I affirm.

Farmers, as a general rule, are a hard-working class of people. I know that sometimes we see an indolent, loafing, good-for-nothing farmer, but they are exceptional; generally they are an industrious class of people; and yet, many of them never manage to surround themselves with the comforts and elegancies of life, while others, right alongside of them, with a similar quantity of soil, and the same seasons, manage to make their labor so productive that they can enjoy every comfort, send their children to college, and give them an excellent start in the world. The latter understands his business and the former does not. Mr. Thrifty,—we will call him,—is raising good Durham, or Devon, or Ayreshire cattle, each head worth from $75 to $100, while his neighbor, Mr. Shiftless, is raising common cattle at the same expense, that will never bring him more than $25 to $30 per head. So you see if Mr. Shiftless can live at all, Mr. Thrifty must have a large margin of profit to put in his pocket. Mr. Thrifty keeps an excellent quality of sheep, raises at least a third more wool to a fleece than his neighbor Shiftless, and the quality is so much better that he gets from five to ten cents more per pound. There is another large margin of profit in his favor, —and so it is all the way through. I know a good many farmers who, if they knew as much about farming as they ought to know, would never keep the kind of stock that they do, and they would take better care of what they kept. They would not have them all day without any shade in Summer, or shivering in the cold without any shelter in winter. They would not sow their seed on land where it is sure to be drowned out by water. They would not skin over the top with shallow plowing, leaving a clump of grass around every stump and stone. They would not allow all the fence corners to bedeck themselves with all manner of useless and ungainly shrubbery. They would not use bars in place of gates. They would rather keep one cow that gave ten quarts of milk than two that each gave six. They would never disgrace their barn-yard with a great long-nosed, large-jointed, crooked-backed hog; they would see that it is vastly more profitable to raise a ton of pork from half a dozen hogs, than two tons from four times that number. They would have their stock ranging in well fenced, well watered, and well shaded pastures in summer, and well fed and comfortably sheltered in winter. They would keep only the most approved bloods. The spade, the plow, and the scraper would be utilized to draw off the surplus water from their fields. They would plow deeper and better. They would pay more attention to the condition of the soil in which they sow, and give less heed to the changes of the moon if they knew how to farm it to profit. There are few places on earth that to me are more delightful than a thrifty farmer's home, where you see neatness, comfort, and taste in the construction and arrangement of the buildings, the fences, fixtures, orchard, garden, and apiary; a green lawn around the dwelling where, in the evening, the old man smokes, the old woman knits, youth and children gambol and play, and lovers plight their troth; the grape vines trained over trellises, whose rich and luscious clusters delight the eye and gratify the taste; the choicest variety of fruits and vegetables supply the table and give zest to toil. Step inside,—what an atmosphere of comfort and refinement is here! Here is food for the mind—a library of scientific, moral, and religious books and periodicals,—there are pictures on the wall, carpets on the floor,—there is a piano or a cabinet organ, and a portly volume of sheet music. Oh, how many times the wrinkles have been smoothed away from the brow of care and the rough edge of temper softened by the sounds of that instrument and the blended voices of children. Oh, I love to expatiate on such a home. There are thousands of them in our country; would to God there were thousands more. In such homes many of the noblest men and women of our country have been nurtured and have gone forth to fill the highest positions in the land, and many more are being nurtured to go forth in due time, and by their noble deeds and honorable lives show that such homes are the palladium of our country. They who would not work for such a home and pray for children to enjoy it, are a disgrace to man and womankind.

Secondly, I know enough about farming to know that much would be gained in many instances by wise distribution or outlay of capital. There has been, and still is, an undue ambition on the part of many to have large farms and a great number of acres under crops. We Americans are a great people to spread ourselves. We have fought so persistently on that line, that we can beat all creation on a spread. It is well enough to have a large farm, if you have the capital to make it productive, but you must remember that, in order to do this, it requires vastly more capital than simply what is needful to purchase the land. If you have just capital enough to get forty acres of land and put it in a high state of cultivation, put suitable buildings and good fences upon it, some choice stock, and the most improved implements of husbandry, you might make from those forty acres a comfortable living and even save money; whereas, if all or nearly all you have is invested in land, you will be working constantly at such a disadvantage that the result will be disappointment, debt, and perhaps bankruptcy; and you will conclude that farming is the hardest and most unprofitable work in the world. There are many men of my acquaintance, who own from a quarter to a half a section of land, who, if they were to go home and sell from a half to a third of it at a fair cash price, and lay out the money thus realized in improving the remainder, and supplying themselves with first-rate implements of husbandry, they would add more than a hundred per cent to their comforts, and not less to the net profits of their operations. There are farmers who have been in the country almost since its first settlement,—their life has been one of hard toil. They have toiled early and late, and it seems as though the longer and harder they toil they are the worse off. Some of them are in debt, for which their farms are under mortgage, and none of them have the comforts about them that they would have had, had their labor been well directed. It is possible to do too much as well as too little labor. To accomplish the desired object labor must be properly directed; so laid out in regard to time and manner as to accomplish the most good. You will find it infinitely more profitable to farm it well upon a small scale, than to farm it upon a large scale, doing nothing well because you undertake to do so much. If a man has ten acres of corn yielding fifty bushels to the acre, he has a handsome margin of profit from the field; but if he has twenty acres poorly tilled, yielding half that amount per acre, it has really cost him more than the crop will bring. If a man's crops cost him more than they will bring in market, then the more he raises the worse he is off. What you do, do well, and never do anything that it does not pay to do well. The defects which are left in nature, and the abundance of supplies which it furnishes, are two features in which we can distinctly trace the workings of that Divine Wisdom which has adapted this earth to be the abode of man. In the abundance of her supplies provision is made for satisfying our wants; in the deficiencies provision is made for the exercise of our faculties. Comparatively few of the earth's spontaneous productions, can be used by man in their primal conditions. In the ordering of God's providential economy toil both of brain and muscle is requisite for the production of many things alike necessary and desirable for human use. The sun may pour forth his effulgent beams, and fertilizing showers may descend, and genial breezes blow over richest soils, but man, if he put forth no effort, will starve on the vestibule of nature's granary. And it is well that this is the case; if the surface of the earth had been formed of matter fit for human food without any process of preparation, this world would be a much less eligible residence for us than it is. This would be a jolly world for a savage, if he had only to go out every morning to the door of his hut and dig up a spadeful of food for the day, but in such a condition of things the race would all be savages. The higher faculties, never exercised, would never be developed. Our Heavenly Father has planned more wisely for His children; He has made us fellow-workers with himself in extracting our food from the earth; and this co-partnership elevates our race. Such is the fertility of the earth and the benignity of the climate in some portions of the world, that abundant food for man and beast grows almost spontaneously, but the inhabitants of those regions do not advance beyond the first rudiments of civilization. Neither within the tropics, nor near the poles, does the human race attain to the highest perfection. In the one case labor is scarcely necessary, in the other it yields almost no remuneration. Both extremes generate a savage idleness. It is in the temperate zones, lying between those extremes, the region where you can get no food without labor, and where skilled labor is rewarded with an ample return, that our faculties, moral and physical, grow to their full stature.

I know of no branch of human industry that is better adapted to the proper development of all our powers than farming if it be rightly engaged in. If you engage in farming in a way that is but too common, you will never realize the truth of this. If you do things in a particular way, just because your fathers did them so, and run along in the old ruts, then you will find farming a drudgery in which the hands do almost everything, and the head almost nothing. I know the impression is by far too prevalent that farming is an employment less worthy of an intelligent and enterprising young man than almost any other calling, and to a large extent farmers are themselves to blame for this. Generally, if they have a son a little smarter than the rest, they educate him with a view to putting him in some other occupation, thus, in a very practical way, holding forth the idea that farming is not a suitable occupation for a man of smartness and culture. Now, this is a great and most mischievous blunder. The application of the principles and discoveries of science to farming is one of the grand progressive features of the age. It furnishes a field of opportunity for cultured minds, such as has been rarely equaled in the history of the race. But the educated only can enter this grand temple of nature, and compel her to tell those secrets that are to benefit mankind. The successful agriculturist of the future must be a man educated specially for his business, and a man of observation, who will make the most of his learning and experience to meet the exigencies that arise, and under whose magic touch the wilderness shall blossom as a garden of the Lord.

Let me relate an incident which shows how Nature reveals her secrets to the educated and observing. The late Prof. Henslow was spending a holiday. Strolling along the beach, he noticed that the stones were singularly light. He sent a specimen to London to a chemical friend, requesting him to analyze it; but, as no fee accompanied the request, the specimen was thrown aside; next summer, however, returning to the coast, the professor was so struck with these stones that he made analysis himself, and then proclaimed to the farmers of Suffolk that whole quarries of fossil guano could be found at their very doors. I presume they used to smile when they saw the professor poking among the rocks and shingle, but I presume they smiled a good deal more when they found that his discovery put two hundred thousand pounds in their pockets, although he did not put any in his own.

Let me say to you in closing: Honor your occupation as farmers; teach others to respect it by making it worthy of their respect; educate your sons thoroughly to it; do not let it be supposed that any dolt can make a farmer. If you have a son that is deficient in brains, do not say that you will make a farmer of that one,—a thousand times better that he should go to the Legislature, for there, in the multiplicity of counsel, there will be some wisdom. He may succeed as a doctor while so many people admire quacks; or, if he has just brass enough, he may succeed as a lawyer; and while gaping crowds like noise better than thought, he may do for a preacher; but do not make him a farmer, for in the general aspect of unthriftiness and mismanagement which his premises will continually present, everybody will see his folly. Had this address been extemporized after looking around your exhibition to day, I should probably have been drawn off into another, and very different train of remark. I might, perhaps, have left unsaid some of the criticisms that I have made, as they refer to an aspect of farming that is not put on exhibition at fairs, but is seen too plainly by driving through the country. However, you have reason to be proud of this fair, the choice specimens of grain, vegetables, and stock you have put on exhibition, show that you are fully abreast of the times. The specimens of needle-work and other evidences of the taste, refinement, and industry of the fair sex, are such as may justly make you proud of your wives and daughters.

SHOEING HORSES.

Horse-shoeing is a subject which seldom receives the careful consideration that its importance demands, for, in all of our management and treatment of the horse, there is perhaps nothing which deserves so much and receives so little attention as that of shoeing. The comfort and usefulness of this our best servant depends on the protection of his feet, in some places all the time, and in all places some of the time; and yet, as a general rule, the horse's owner knows little and cares less about how the animal ought to be shod, and lets the nearest blacksmith, more ignorant and careless than himself, have the entire control of the shoeing, being content if the shoes stay on long enough, and the horse does not limp. Should either of these things happen he berates the blacksmith or his horse, but takes no pains to find out the cause of the trouble.

It is wonderful the amount of ignorance displayed by the owners of horses, and especially by blacksmiths, and what ideas they do have on the subject are many of them wrong. But there is some excuse for this in the fact that many false theories have been taught by men who claimed eminence in the veterinary art.

It is well for us to look into these things, for there is nothing that will tend more towards improving the condition of this most valuable animal. This is plainly shown in the fact that investigation into cases of cruelty to animals shows that a great majority refer to the horse, and the most of these to working-horses, suffering from lameness which can be readily traced to faulty shoeing.

It is wonderful and painful to see how many horses are affected in this way.

The subject is receiving much attention in European countries, and it behooves us to give it some thought and study; to investigate the principles and practices of shoeing; to study the anatomy of the foot, and the functions of the different parts; ascertain if the operations of the smith are in accordance with natural laws, and wherein these operations can be improved.

A brief description of the external parts of the hoof will be all that is necessary for our present purpose.

The hoof is divided into the crust, the sole, the bars, and the frog. The crust, or wall, is the outer covering of the hoof. It is all that we can see of the hoof when the foot is flat upon the ground. In substance it is like horn, and very hard. It is composed of layers, dovetailed together so compactly as to render it almost impossible to separate the layers without tearing them. The wall is insensible and slightly elastic; it is thickest in front, gradually growing thinner at the sides, but thick and strong at the points of the heels. It is about the same thickness from bottom to top.

In a healthy state the wall has a sort of waterproof coating, of a slightly lustrous substance, like varnish, which seems intended as a protection against the action of the atmosphere. Hence, the common practice of rasping this surface is very injurious, for as soon as this coating is removed the wall becomes speedily dry and unhealthy. The rasp should not be allowed to touch this surface, except to remove the little shreds caused by the nails. Under no pretext whatever should the smith be allowed to *shape* this portion of the wall, however plausible may be his theories as to its utility or necessity. The natural shape is the only right one.

The crust grows downwards, or in the direction of its fibers, at an average of about a quarter of an inch a month, which is about equal to the wear when the animal is running loose or working on soft ground. On the paved streets of the city, on hard, dry gravel roads, and everywhere in frosty weather, the wear is greater than the growth, and some protection is necessary. Nothing has been found which answers the purpose so well as a plate of iron nailed to the bottom of the foot.

When the foot is thus shod, of course this wearing away is prevented, and the extra growth must be cut away at each shoeing. This can be much more evenly done with the rasp than any other instrument, and care should be exercised that only enough of the wall is taken off to leave the hoof in the proper condition and shape, otherwise injury may result from undue strain of some of the tendons.

Next within the wall is the sole, the two being connected by a ring of horn softer than either. The object of this ring seems to be to prevent the danger of jar and fracture to which the inner parts of the hoof, especially the sole, would be liable if the comparatively hard and inelastic wall and sole were united without its aid.

"It may be remarked that it is through this soft ring that gravel and other foreign substances find their way to the sensitive parts of the foot." Small bits of gravel will sometimes work clear up and come out at the top of the hoof, causing the animal much pain. The sole is horny like the wall, but is less dense and hard, and more elastic. It seems to be more adapted to sustain weight than to stand hard wear. It is thickest and hardest next to the wall, and thinnest and most concave at the center. Its shape seems to indicate that it is not intended to come much into contact with the ground, but to be gradually relieved from wear towards the center.

"A notable peculiarity in this part of the hoof, and one which distinguishes it from the wall, is its tendency to break off in flakes on the ground face when the fibers have attained a certain length."

The bars are simply continuations of the wall, turning under the foot at the heels, and gradually diminishing until they disappear at a point near the center of the foot. In the angle formed by the bars is the frog. It is triangular in shape, with the base between the heels, and is partially divided by a shallow cleft.

"The substance of the frog is eminently elastic, and corresponds in the closest manner to the dense elastic pads on the soles of the feet of such animals as the camel, elephant, lion, bear, dog, cat, etc., and which are evidently designed for contact with the ground, the support and protection of the tendons that flex the foot, to facilitate the springy movements of these animals, and for the prevention of jar and injury to the limbs."

In the horse's foot the presence of this thick, compressible, and supple mass of horn at the back of the hoof, its being in a healthy, unmutilated condition, and permitted to reach the ground while the animal is standing or moving, are absolutely essential to the well-being of that organ.

The frog, like the sole, flakes off at certain stages of its growth; but it must be remembered that this exfoliation only takes place when the horn beneath is fully developed, and has acquired sufficient hardness and density to sustain contact with the ground and exposure to the effects of heat, dryness, and moisture.

This fact that these two parts have the power of thus disposing of their extra growth is sufficient and conclusive proof that they need not be cut away in the operation of shoeing. The arguments against the practice are many and strong.

Mr. George Fleming, an eminent English veterinarian, from whom I have already quoted somewhat, says on this subject:

"This procedure is as barbarous as it is unreasonable, especially when carried to the extent that has been advised in books on horse-shoeing,—that is, to pare the sole until it yields to the pressure of the thumb. In the great majority of forges this most pernicious practice is carried out because the owner of the horse thinks it necessary, the groom or coachman that it makes the horse go better and the feet to look well, or the farrier that it is more workmanlike,—though if he is pressed hard for any other reason, he is unable to give one of a satisfactory character.

"Like so many practices relating to the management of the horse, this paring of the sole is absurd in the extreme, and has not the most trifling recommendation to support it.

"Unfortunately for those who recommend, and also those who practice it, its evil effects are not immediately apparent. A horse with his soles denuded until the blood is oozing through them, may not at the moment manifest any great suffering, and may even go tolerably sound on a level pavement, though if he chance to put his foot upon uneven ground or a sharp stone, his agony may be so great as to cause him to fall."

To remove the excessive growth of the *wall* is an absolute necessity; but to denude the *sole* of its horn is wanton injury to the foot, and cruelty to the animal. This is easily accounted for. The *sole* only increases in substance to a certain thickness, never too much, and then the excess is thrown off in flakes in the natural manner. In this way the sensitive parts are amply protected; the sole can sustain a share of the weight,—especially around its margin in front, where it is strongest,—and can meet the ground, however rough and stony, with perfect impunity.

"This exfoliation takes place slowly, the flakes clinging to the sole until forced off by new ones forming underneath."

Horn is a slow conductor of heat, cold, and moisture; hence, these flakes keep the feet cool and moist, ensure for the growing horn underneath a proper development, and act as a spring in warding off bruises or other injuries from the sole.

"What occurs when the smith, following out the routine of his craft, or obeying the directions of those as ignorant as himself, pares the sole until it springs to the pressure of his thumb?"

The lower surface of the foot,—that which is destined to come into contact with the ground, and to encounter its inequalities, and which, more than any other part of the foot, requires to be well guarded,—is at once robbed of its protection, and exposed to the most serious injury. The immature horn, suddenly stripped of its outer covering, immediately begins to feel the evil effects of external influences; it loses its moisture, hardens, and shrivels up. It also occupies a smaller space, and in doing so the sole becomes more concave, drawing after it the wall.

The unmutilated sole is a great protection against contraction. Not only is pain and uneasiness felt during progression, but even in the stable, the horse whose soles have been thus barbarously treated exhibits tenderness in his feet by resting them, and their temperature will be found too high. This paring disturbs the secretory apparatus of the foot, and new horn is made more slowly; but no sooner is new horn formed, and the horse begins to stand easier and travel better, than it is time for him to be re-shod and the sole again denuded.

To counteract the evils of all this, shoes of absurd shapes have been invented, plates of leather put on under the shoe, and stuffed with tar and all sorts of filthiness, all of which are very poor substitutes for that which has been so foolishly cut away. All of these remarks and arguments apply with equal force to the mutilation of the frog.

Although many of the later writers on the subject have severely deprecated the cutting of the frog, it is still practiced, and the effect is perhaps more injurious to the foot than that of paring the sole. We have abundant and conclusive proof that the frog should bear upon the ground where the horse is standing or moving; but if its outer covering is removed it cannot do so. Imagine yourself attempting to stand with even a very small bit of skin stripped from the sole of your foot, and you will appreciate the effect of this paring at once. The function of the frog in the animal economy is of great importance. It is eminently adapted for contact with the ground, and in this resides its most important office. To remove it from the ground and deprive it of its horn is at once to destroy its utility and structure, and withdraw from the foot one of its most essential components. The longer the frog is left untouched by the knife, and allowed to touch the ground, the more developed it becomes; its horn becomes so dense and resisting, yet without losing its special properties, that it braves the crushing of the roughest roads without suffering in the slightest degree; it insures the hoof retaining its proper shape at the heels; is a valuable supporter of the limb and foot while the animal is standing or moving, and is an active agent, from its shape and texture, in preventing slipping. Its reduction and removal from the ground have a tendency to produce many painful and often incurable maladies, while many cases of lameness have been cured by simply shoeing the horse so that the frog must bear upon the ground.

Another very injurious practice is that of opening up the heels. This consists in making a deep cut into the angle of the wall at the heels, where it bends inward to form the bar, and is quite as injurious, perhaps more so, than mutilating the sole and frog. In the natural state this is a particularly strong portion of the hoof, and serves a very useful purpose, its utility being mainly owing to its strength. When it is hacked away by the blacksmith's knife, the wall is not only considerably weakened, but the hoof gradually contracts at the heels, both of which are seriously injurious. This fashion of paring away the sole until it yields to the pressure of the thumb, and opening out the heels, has been largely due to the theories of some writers regarding the functions of these parts,—such as the descent of the sole and the expansion of the back parts of the hoof every time the weight is imposed upon it.

Writers who have been considered authorities on these subjects, such as W. H. Herbert (better known as Frank Forester), Dr. Jennings, and others, have advocated these practices, and have cited the functions just mentioned as proof of their need.

Without discussing the correctness of these theories, let us inquire,—do they prove such need, and does the practice look reasonable or natural? In all of our treatment of the horse's foot our sole endeavor should be to keep all the conditions as nearly natural as possible. It has never been maintained that the unshod hoof needs this mutilation,—then why that which is shod? The unshod hoof on soft ground bears some weight over its whole surface,—why may not the shod hoof? Admit that the sole descends at every step, it must do the same in the unshod hoof without injury. The theories themselves seem to have no foundation; but aside from that, I think it can be readily seen that the deductions from them are illogical and unsound. "It should ever be most strenuously insisted upon, that the whole lower face of the hoof, except the border of the wall, *must* be left in a state of nature; the horn of the sole, frog, and bars, has an important duty to perform; it is the natural protection to this part of the hoof, and no protection of iron, leather, or other material, is half so efficacious; in addition, it is a capital agent in sustaining weight, and in keeping the whole foot healthy and perfect in form.

Having prepared the hoof properly, let us look at the shoe, and see how that agrees with natural laws, and how it can be improved.

The shoe generally used seems to be faulty in several respects. It is nearly always too heavy. It is found that an animal wearing a two-pound shoe and traveling at the rate of sixty steps a minute for four hours, will lift a weight equal to more than fifty tons (115,200 lbs.). This enormous exertion must be a great strain upon the powers of the animal, and it is cruel to cause him any of it unnecessarily. The whole foot is constructed with reference to lightness and rapid motion, with consequent loss of power, and it should be our aim to interfere with this as little as possible.

"Not only does the heavy shoe fatigue and wear out the foot sooner than a light one, but it is less durable in proportion to the amount of iron, for the tired limbs drag their heavy load along the surface of the ground."

Heavy shoes, too, require more and larger nails, which is in itself an evil of no trifling nature. The shoe needs to be only heavy enough to prevent it from springing and wearing out before the animal needs to be reshod. There will be little danger of springing if the shoe fits right.

The present practice is to bevel off the inner side of the foot surface of the shoe, so that only the outer edge of the wall rests on a narrow rim of the shoe. When the firm, solid horn has been all cut away from the sole, this beveling may be necessary; but when the sole has been left as it should be, the shoe may and *should* fit down snug for its whole width.

This beveling leaves a wide, open space for the accumulation of gravel, mud, snow, and many things likely to injure the foot, and on heavy roads the suction is increased immensely.

They are generally wider than is necessary. I can see no need for their being much wider than the thickness of the wall, if this is enough for strength and a solid nail hold.

The wall is the only part that we need to protect from wear. The narrower shoe will be much better protection against slipping, and will require fewer and smaller nails.

The shoe is often made too small, and then the hoof trimmed down to fit it,—a practice which cannot be too strongly condemned,—as thereby a portion of the best and strongest part of the hoof is taken away, and the hoof misshaped. The shoe should be made to fit the foot, not the foot the shoe.

The *fullering* or groove made for the nail-heads is entirely unnecessary. It is said to prevent slipping, and may when the shoes are first put on and the nail-heads are large; but after the shoe has been worn awhile the groove becomes filled with earth, hard and smooth, and affords no such protection.

The objections to it are that it weakens the shoe, rendering greater thickness necessary, and the protruding nail-heads are liable to become bent or broken. Simple counter-sunk holes, with nails made to fit exactly, are preferable in every way. The shoe will wear longer and stay on better with fewer nails.

More and larger nails are used than is necessary. Five to seven have been found, if properly used, sufficient to hold the shoe as firmly as more, under ordinary circumstances. The size of the animal, and the nature of his work and the roads, would of course need to be considered.

The calkins generally used are a source of great discomfort, and often a serious injury. The animal is liable to cut himself, or his mate if used double. Depending on them when sharp, he is liable to be timid and travel poorly when they are a little worn.

The calkins raise the foot so high that the frog cannot touch the ground, especially where the roads are very solid. Their value and usefulness are very questionable under ordinary circumstances, and they should only be used when the extreme iciness of the roads render it absolutely unavoidable.

It has been found on repeated trials that, if the roads are not icy, horses slip no more, and work with much greater ease without the calkins than with them.

A form of shoe has been recommended which seems to obviate the necessity of calkins to a great extent, and at the same time has the advantage of rendering the shoe lighter without much affecting its strength. It consists simply in changing the bevel from the foot surface of the shoe, where it generally is now, and putting it on the opposite side, or the ground face of the shoe. This, you will see, makes the shoe very like the bottom of the hoof in shape, decreases its weight, and renders it much more effective than the ordinary shoe in the prevention of slipping.

The simple fact that it corresponds so nearly to the ground surface of the foot in shape should be sufficient recommendation for its use.

A slight modification in form would increase its efficiency in preventing slipping, and render it still more like the foot in shape. This is simply to stop the bevel abruptly within a short distance of the ends of the shoe, thus leaving a sharp corner, which answers very well both in shape and use to the heels in the unshod hoof. By having the toe of the shoe fixed in a similar manner, I doubt if the horse would slip on any roads, and he must certainly be much more comfortable under ordinary circumstances than with the long calkins he now wears.

Some writers recommend turning up the toe slightly to prevent stumbling. The fact that some horses seem to travel better after they have worn off the toes of their shoes a little, would seem to recommend it for those horses at least.

The use of clips, or little projections from the shoe up the side of the foot, seems to be of advantage in many cases in holding the shoe in its place and rendering fewer nails necessary; but care must be taken not to have the nails and clips too near together: "Lameness is not unfrequently produced by a tightly adjusted clip making so much pressure upon the nail and horn within as to cause pain and inflammation."

Having decided upon the form of shoe, the next thing is to apply it to the foot and fasten it there.

Usually, the smith selects a shoe which he *guesses* is about right,—shapes it in conformity to his own ideas, or as he has been taught,—and then proceeds to fit the foot to it. He generally gets it too small, and so must cut away a portion of the hoof, thus depriving the limb of a part of its basis of support. This is all wrong. The wall should be cut down to its natural dimensions,—"the part of the hoof to be protected by the iron rim made as level as possible by the rasp; the surface of the sole destined to rest on this horny bed should also be made perfectly level and smooth."

"The shoe should be so molded that it will be an exact reproduction in outline of the circumference of the hoof.

For fast traveling horses, the shoes, especially the front ones, should not project back of the foot, and the ends should be carefully rounded so that the animal will be in no danger of stepping on them with his other feet. In draft horses it is sometimes an advantage to have the shoes project slightly back of the foot.

To insure the perfect fitting of the shoe to the foot, it should be fitted in a hot state. The two systems of fitting shoes, in a hot or cold state, has been severely tested, and the result is that cold fitting is almost never used. The evil supposed to arise from hot fitting are purely imaginary, for when any are apparent they can easily be traced to the operation of other causes, not the least of which is paring the lower face of the foot.

The great objection to cold fitting is that the shoe cannot be made to fit closely, and hence will not be at all comfortable to the horse, and will soon become loose. It requires much more time to put on the shoe.

"In hot fitting we have none of these objections. The shoe is very readily adapted to the foot; it is more equally applied, and rests solidly on the hoof, so that the nails are not broken or displaced by the shoe becoming loose." It is the only way that so perfect a fit can be obtained that the shoe shall bear equally on every portion of the hoof.

The very fact of burning or fusing the ends of the fibers insures a solid, durable bed, which cannot be obtained otherwise, as this destroys the spongy, absorbent properties of the horn, and renders it less affected by moisture.

Horn is so slow a conductor of heat that several minutes are needed to produce any change in temperature, at even a short distance, while the hot shoe needs to be kept in contact with the hoof but a few seconds.

The shoe should be fitted at a red heat, as this is far more effective in producing a solid, level surface.

The nails should not be unnecessarily large, as is often the case, but well proportioned to the size of the shoe. The heads should be just large enough to fill the nail-hole when driven in firmly. It is scarcely necessary to add that the nails, like the shoe, should always be of the best material. In driving the nails, every one should be made to pass through sound horn. It is a mistake to place them where the horn is broken, or in old nail-holes. Care should be exercised that the nail be directed so that it will come out at the right place the first time. Driving the nails through the hoof, even once, is an injury, and if it be so carelessly done that the nail must be withdrawn and put in a new place, the injury is proportionately increased. A short, thick hold of the wall is better than a thin, long one. If possible, no more horn should be included within the grasp of the nail than is likely to be removed at the next shoeing. By this means the wall is constantly kept sound.

"Where the wall is thin, as at the quarters and heels of the fore foot, smaller and more slender nails should be used, and these not drawn so tightly. The toe nails should be driven up tight. The points having been twisted off, they should then be drawn up by the pincers, the ends filed off to a proper length, and then the clenches laid down evenly on the face of the wall.

"The rasp removes the little barb of horn raised in drawing up the nail but without making a notch." No more rasping or cutting should be allowed on any pretense whatever.

The clips when used should now be applied close to the hoof but never driven into the hoof.

Horses should be re-shod in from four to six weeks, but if they could go without shoes for a portion of the summer they would be greatly benefited thereby.

It will be readily seen that the observance of these few rules would greatly simplify the operation of shoeing, and the result would be a great saving of time and expense, in addition to the advantages we have mentioned in the preservation of the health of our horses' feet.

Let us briefly recapitulate and see how simple a matter it is and how few rules to be remembered.

In preparing the hoof for the shoe nothing but the wall is to be cut in any way, and only the extra growth taken from the wall, which will be just down to a level with the sole.

The shoe to be as light as possible, perfectly flat and level its whole width on the foot surface, and flat or slightly beveled on the ground face. To be made to fit the foot perfectly, and fitted hot, so that it shall press evenly on the wall and so much of the sole as may be necessary.

The nails to be as few and as small as possible, and made to fill the hole in the shoe exactly.

That calkins are necessary only in the most icy state of the roads, but when used to be put on both heels and toe.

There you have the whole matter in a nutshell; any one can remember it, and almost any one can apply the rules, if they will, which is quite an important item in these days of poor workmen.

I am convinced that the application of these simple principles would save many dollars in money, many hours in time and an untold amount of suffering in our good beasts.

FARMING IN THE UPPER PENINSULA.

Hon. H. G. Wells, President State Board of Agriculture:

MY DEAR SIR—Appreciating the interest you take in the agricultural progress of the State of Michigan, I beg leave to call your attention to the fact that that portion of that commonwealth, known as the "Upper Peninsula," has never received recognition at the hands of the State "Patrons of Husbandry." This is owing, no doubt, to the popular idea that the resources of this "far off" region come only from the "bowels of the earth." It is true the prominent business of that section of our State is directed mainly in the channels of mining for copper and iron; but while great attention has been—and is still—given to the production of these useful metals, the farming cababilities,—if I may be allowed the expression,—of the country have been sufficiently tested to warrant the belief that under a system of thorough husbandry, certain cereals, together with hay, potatoes, and what would come under the head of "garden esculents," can be produced up there to advantage. In the way of approximate intelligent farming in the Upper Peninsula, Ontonagon is ahead of all other counties in that region. In that locality wheat, oats, barley, corn, potatoes, apples, etc., etc., etc., thrive well, even in the face of a disregard for well known laws governing the economies of husbandry.

Since the introduction of railroads in Marquette and Houghton counties,—the two most thickly settled and prosperous districts in the Upper Peninsula,—a large number of acres of excellent farming lands have been made available, which only require the assistance of the skilled and industrious tiller of the soil to make them yield handsome profits. Hay raised in the Upper Peninsula is far superior to any imported into that country; while the potatoes produced "up north" are equal to any grown in the world. A valuable feature in connection with farming in the Northern Peninsula is found in the fact that a good home market awaits the farmer, who can always obtain the highest price for his products.

I regret, exceedingly, that I have not at hand fuller data, touching this subject; still, if this hurried and ill-prepared note will serve to call attention to one of the best and least appreciated farming regions in the northwest, I shall feel satisfied. Truly yours, etc.,

J. R. DEVERAUX.

LANSING, Mich., Sept. 3d, 1873.

AGRICULTURAL LABORERS:

THEIR DIFFICULTIES IN ENGLAND AND SUCCESS IN MICHIGAN.

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BY HENRY S. CLUBB.

THEIR DIFFICULTIES IN ENGLAND.

The movement of agricultural laborers in England, although assuming formidable proportions, has at present resulted in very slight concessions on the part of the English yeomanry and landlords. The English farmer is not altogether to blame for the deplorable condition of the laboring classes. He does not own the land he tills, and he is compelled to economise in order to be prepared: *First,* For the payment of his rent; and *Secondly,* For the payment of his *tithes.* So long as the land is owned by the aristocracy, who neither "toil" nor "spin," and who are simply ornamental figure-heads to the great body politic, and so long as the church is connected with the State, and the tithe system prevails, so long will it be impossible for English farmers to pay an adequate proportion of the proceeds of their farms to those who perform the labor; whose toil is in fact the source of all their prosperity, and without which England would soon become a wilderness.

Drinking Customs.

But the cause of distress among the agricultural laborers is not alone attributable to the predominance of the landlord class, or of the Church and State party; but it is, in a great measure, attributable to a very general habit of spending their few hard earnings at the village inn. English beer is largely consumed, even by those whose wages are really inadequate to supply the necessities for themselves and dependents. This love of intoxicating beverages is the great bane of English laborers. It affects not only their moral and social standing, but it is indirectly the cause of their political degradation. The ruling classes, under a pretense of restricting and regulating the sale of intoxicating liquors, really license and encourage it. The malt tax, the excise on spirits, and lastly the "license to retail wine, beer, and spirits," are all so many sources of revenue to the governing classes. Every two pence expended by the laboring man at the ale-house furnishes to the ruling classes additional power with which to maintain the unhallowed union of church and State, and at the same time sustain in idleness and luxury the landlord class, while it enfeebles the laborer, and makes him less vigilant in maintaining his own rights as a citizen or subject. The excise and license system of England is a source of immense power to the ruling classes, and of debasement to the laboring portion of the community. It is one of the main instruments of despotism and oppression. The church, which should be the guardian of moral purity, is interested, by its connection with the State, in this degrading vice of intemperance. It, with the State, is interested in the moral degradation of the people, as the State itself, with all its dependent institutions, would lose its principal source of revenue were the traffic in intoxicating liquors abandoned or prohibited. So that, by the practice of a little self denial and temperance, the laboring classes of England, with all the fearful odds against them, possess the means in their own hands of accomplishing their own moral, intellectual, and political elevation. But a reform so thorough cannot be expected, while temptation in its most alluring forms, under the authority of law, is placed in their way. The young men follow the example of their fathers.

"For they are the same their fathers have been;
They see the same sights that their fathers have seen;
They *drink the same stream* and view the same sun,
And run the same course their fathers have run,"

and so the evil continues. The efforts of such men as Arch Hodges, and others, are in a great measure frustrated by the intemperate habits of the people they are striving to elevate. No sooner is a strike inaugurated, with a view to bringing the obdurate farmers and landlords to a concession of justice to the laborer, than the village green becomes the scene of drunkenness and disorder; the inn deals out the tempting draught; every resource of the working man is expended in debasing instead of elevating himself, and the result is defeat and disaster to the working man. Those of the middle and upper classes who would delight in helping the cause of the working man are deterred by these exhibitions, and their sympathies are averted from the cause.

Not all Intemperate.

In the midst of all this appalling weakness and degradation, disappointment, and discouragement, may be found men of steady, sober habits,—men who are frugal, industrious, and persevering,—but who, although in comparatively comfortable circumstances, are nevertheless kept down by the evils which surround them. They get no more wages than are given to their less worthy neighbors; the system is crushing them, although they deserve not the punishment it inflicts. Then the children growing up in ignorance become the innocent victims of the circumstances in which they are unfortunately born and raised. The hope of immediate improvement in the condition of the laboring classes of England is very slight, so beset are these classes with temptation on the one hand, and so ground down with incessant toil on the other. What, then, is the remedy?

OBJECT OF THE VISIT OF JOSEPH ARCH.

To solve this difficult problem is the occasion of Joseph Arch's visit to America. He has come to see if this is a country where labor meets with its just reward, intending to return and report to his countrymen the result of his investigations He will undoubtedly be cordially received in all parts of the United States and the Canadian dominion. And here he will find a true solution. In no country on the face of the globe can the laboring man enjoy so completely the fruition of his labor as he can here.

MICHIGAN ADAPTED TO ENGLISH LABOR.

Politically, every State in the Union is supposed now to present the same advantages to the immigrant; but there are considerations arising from differences of location, climate, soil, and resources, both natural and acquired, which render the territory embraced within the boundaries of Michigan peculiarly adapted to the English laborer, whether agricultural, mining, or manufacturing.

But before considering the special adaptedness of Michigan to English immigrants, let us glance at the political advantages offered by the United States, as compared with those of England.

POLITICAL ADVANTAGES OF THE UNITED STATES.

Without desiring to detract from the acknowledged advantages possessed by England, as a nation, for manufacturing, nor even in the stability and strength of her government, and the power of her municipalities in preserving order and enforcing obedience to law, we claim that the United States of America is peculiarly the place for the working man. In this country aliens are treated with consideration, and are protected in all their rights of life and property. A man becomes a citizen just as soon as, with ordinary intelligence, he can become sufficiently familiar with our laws to exercise the rights of citizenship with advantage to himself or the State. Being a laborer is accounted an honor rather than a discredit, and his labor is sought for at good remunerative prices. His "right to life, liberty, and the pursuit of happiness" is secured to him by the fundamental law of the land,—not specifically in the original Constitution, but in the Declaration of Independence, which is a prior authority, and in general terms in the Constitution, while subsequent amendments of that Constitution have tended to engraft upon that instrument the principles enunciated in that declaration.

No State Religion.

One of the first principles engrafted upon the Constitution by amendment was that which renders the establishment of a State religion impossible; no tithes therefore can be imposed. The amendment declares that Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof, or abridging the freedom of speech or of the press, or the right of the people peaceably to assemble, and to petition the government for a redress of grievances.

Constitutional Rights.

Other amendments secure the following rights to the citizen: to bear arms; to be secure in person and home against unreasonable searches and seizures; not to be tried for high crimes without proper indictment; not to be put in jeopardy twice for the same offense, nor compelled to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law, nor of property for public use without just compensation; trial by jury; to be confronted with witnesses against him; to have compulsory process for witnesses in his favor, and to have the assistance of counsel; against excessive fines and cruel or unusual punishment; not subject to slavery or involuntary servitude except for crime; all persons born or naturalized are citizens, whose rights to vote, etc., no State can abridge. While these rights are enumerated, other rights, not enumerated, are held sacred. These fundamental principles of justice and right are secured to the citizen and his posterity, and cannot be taken away without the action or consent of two-thirds of the members of Congress, and the ratification by the legislatures of three-fourths of the States, all of whom are jealous of any infringement on the rights of the citizen.

Rights not enjoyed in England.

While some of these rights are obtained from the fundamental law of England, there are others which the English government have not yet conceded to the people, and which the people can only enjoy by coming to the United States. Chief among these are the freedom from religious intolerance, and from the compulsory support of a religious institution; the entire freedom of speech and of the press; the right to bear arms, rendering the existence of a large standing army in time of peace unnecessary; and other rights which will be readily recognized.

Control of Legislation.

The effect of the exercise of these political rights is to secure to the laboring man laws favorable to labor. Working men being the most numerous portion of the elective power can, and generally do, elect men favorable to their interests.

The Free Homestead System.

But besides these great civil, political, and religious rights, the citizens of the United States, and those who come here with the intention of becoming citizens, have, within their command, advantages which render labor particularly remunerative. The homestead law, which secures the actual settler one hundred and sixty acres of land—or, if near a railroad, eighty acres of land—free of cost, makes a wide difference between the condition of the agricultural laborer of England and the agricultural laborer of the United States. The man who is accustomed to farm-work can by his own labor not only become a farmer, enjoying all the fruits of his own toil, but he becomes the owner of the land he cultivates, and, in a few years, as settlement increases around him, he finds himself not merely a farmer owning a cheap farm, but, in all probability, he finds himself the owner of land of great value; perhaps as an improved farm, or it may be of real estate valuable for commercial or residence purposes, securing him an ample independence, and a valuable inheritance for his children. All this is within the reach of many, and, so far as a valuable farm is concerned, of all agricultural laborers who choose to avail themselves of the advantages offered. No chance of this kind is offered to the laborer, and seldom even to the well-to-do farmer, in England.

Effect of the Homestead Law on Wages.

The effect of this homestead privilege is to draw constantly from the labor market, leaving it with less laborers than can supply the demand. The effect of this on wages is wholly in favor of the laborer who remains, and makes his services indispensable. This is the secret of the high rate of wages which laborers command in the country. This also produces a corresponding depression in the price of unimproved land, so that land not owned by the government can be had at reasonable prices in settled portions of the country, so that those who do not like the isolation of pioneer settlement can always procure land adjacent to established settlements.

Labor first for Hire.

While, therefore, we regard the free homestead privilege as one of great importance to the agricultural laborer, it does not follow that we should advise all to avail themselves of it at once on arriving in this country. The early privations incident to settling new country would be lessened and the work of establishing a home in the forest rendered much more pleasant if the settler, without capital, would content himself to labor for hire a few years first, as it would enable him to start with a capital that would procure comforts during the first few years, and until the produce of his farm could be brought to a profitable point, and of sufficient market value to command a compensation for the labor invested. No class of men could command better compensation, as laborers, than the average agricultural laborers of England.

Land in Exchange for Labor.

There are many farmers in America who have more land than they can profitably cultivate, and they would willingly dispose of portions of their land in return for labor on their farms.

Labor, other than Agricultural.

Even if agricultural labor should ever prove over-stocked, there are other kinds of labor, such as railroad, highway, canal, and bridge building, while the mining regions furnish profitable employment for all who will engage and are able to perform labor.

NATIONAL INDUCEMENTS TO THE ENGLISH EMIGRANT.

All we have thus far said, and much more can be said, in favor of the United States, as offering to the surplus agricultural laborers of England the strongest inducements to emigrate, leaving at home only so much of the laboring element as can command remunerative prices for labor.

STATE INDUCEMENTS TO THE ENGLISH EMIGRANT.

All the afore-mentioned advantages are offered in Michigan, and others not yet enumerated.

Homestead Exemption.

In addition to the Constitutional privileges secured by the fundamental law of the United States, the Constitution of Michigan protects the personal property of every resident of the State to the amount of not less than five hundred dollars, the homestead of not exceeding forty acres of land, and the dwelling house thereon, and the appurtenances to be selected by the owner thereof; or instead thereof, any lot in city or village, and dwelling house thereon, not exceeding in value fifteen hundred dollars, from any forced sale on execution, or any other final process from a court, so that once a resident and owner of a home, no amount of misfortune can ever deprive the settler in Michigan of that home. It is as sacred as the palace of a king, and of more certain tenure.

Hon. Solomon L. Withey, on his motion to increase this amount of exemption to two thousand dollars, in the Constitutional Commission of 1873, eloquently portrayed the moral advantages of this homestead exemption. He showed that the influence of a permanent home on a family of sons and daughters was so important that no edict of a court, however just, should be allowed to deprive the family of that influence, and that in making this provison of the Constitution, the State was protecting itself from evils which would inevitably result from the breaking up of families were homes subject to execution by the sheriff. The value of the exemption will undoubtedly be increased by the adoption of amendments proposed.

No Imprisonment for Debt.

No person can be imprisoned for debt except in cases of fraud or breach of trust. All votes are given by ballot.

Free Schools, Colleges, Etc.

Free schools, supported by school funds derived from public lands and by taxes on property, are secured to the people, so that no matter how large the family or how poor the parents, nothing can deprive children of an education if residing within a school district. The school house is usually the first public building erected in a new settlement, and in old settled places it is usually the finest structure. The schools are free from denominational control, and are conducted entirely on unsectarian principles. A first-rate University and a model farm and Agricultural College are also provided and handsomely endowed; both accessible to the people at trifling cost.

Libraries.

Town libraries, free for all citizens, are established by fundamental law, and supported by the proceeds of fines and forfeitures.

Property Taxation.

The taxation is on property equally assessed. Those who have no property pay little or no taxes. In this way the poor man cannot be oppressed by heavy taxation.

Protection to Labor.

Stockholders of corporations are individually liable for the labor performed for the corporations.

Private Property.

Private property cannot be taken for public use without the consent of the owner, or proper compensation.

Rights of Aliens.

Aliens who become *bona fide* residents of the State, enjoy the same rights, in respect to the possession, enjoyment, and inheritance of property, as native born citizens.

Control of Railroads.

The Legislature has power to establish reasonable maximum rates of charges for transportation of passengers and freight on railroads.

Statute Law.

In addition to these provisions of fundamental law, the statutes provide ample protection to life and property.

State Lands.

The State hold lands at reasonable prices, and on very easy terms for settlers thereon.

Railroad Lands.

Lands granted by the United States government for aiding in the construction of railroads, are held by the respective railroad companies, and sold by them to settlers on very easy terms for payment, so that homes can be readily obtained near to railroad stations.

General Policy.

The whole policy of the State, and of owners of land, is to afford facilities to settlers, and give them every possible advantage in the establishment of homes. All are alike interested in increasing the population, and especially the laboring population of the State.

Michigan Fruit.

Fruits, such as peaches, apricots, and grapes, which cannot be grown in England without wall-protection or glass covering, are produced in Michigan along the shores of the lakes, in the open field, as standards or on trellises, without any protection. The lake breeze is highly beneficial to these usually tender fruits, while away from the lakes, and in the interior of the State, the apple crop has already assumed gigantic proportions, Michigan apples being exported east and west in large quantities, some having reached the shores of Great Britain, and been thought worthy to adorn the tables of Buckingham Palace. The astonishment of English immigrants is always expressed at the size and excellence of Michigan fruit.

Facilities for Transportation.

The waters of the lakes are not only beneficial in modifying the climate, but they afford the best means of transportation to markets. Connected with the large lakes by rivers are innumerable smaller or inland lakes, by some estimated at five thousand. Around these little lakes, and along the connecting rivers, the farms, orchards, and vineyards are located, and in the fruit season small steamers take the produce without its being jolted on wagons, and it is landed in the best possible condition in the large cities, where the demand has become great for all the fruit that can be produced.

Farm Crops.

While the growth of fruit of great diversity and superior quality has become an established business, the cultivation of general farm crops of winter wheat, oats, rye, barley, beans, and hay; cheese and butter, beef, pork, and all the other crops usually grown in England, has been successfully pursued. Michigan white wheat, and the flour produced therefrom, stand foremost in the Eastern markets.

Water-Power.

The State is so well supplied with streams and lakes that water-power is obtainable in every neighborhood for mills. Hundreds of water-powers remain undeveloped in the State, while steam mills are already numerous.

Soil and Topography.

The soil of Michigan presents all the diversity of sand, sandy loam, clay, and gravelly, while the topography is well varied by hill and dale, table land and rich meadow bottoms. Few farms of one hundred and sixty acres but contain several kinds of soil, while the under or subsoil is equally diverse. In many of the margins of lakes and streams, peat, black muck, and beneath these, white marl beds, of great depth and purity exist, affording an unlimited supply of fertilizers. Even the sandy regions of the lake shores are remarkably fertile,—the sand being largely permeated with lime in the form of shells pulverized by the action of the water. In this sand, pine, oak, beech, maple, hemlock, spruce, and cedar grow luxuriantly and spontaneously, while the fruit trees, already enumerated, make surprisingly rapid growth, even when planted in a soil that, to all appearance, is of an unproductive character.

Farm Orchards.

Many farmers, who commenced in Michigan twenty or thirty years ago, not knowing the capabilities of the soil, planted fruit trees but sparingly, but have been surprised to find their orchards among the most profitable features of their farms, in many cases enabling them to pay off their mortgages.

Climate.

The climate of Michigan, modified as it is by the great stream of water know as lakes Michigan, Superior, Huron, St. Clair, and Erie, and the connecting straits and rivers, is rendered particularly grateful to the English settler. In the summer the heat is moderated by a regular breeze from the water, and in the winter the excessive cold is moderated by the same breeze, warmed by the stream, which cannot freeze over, just as the climate of England is warmed by the stream from the Gulf of Mexico. We consider, therefore, that in Michigan the English emigrant experiences less difficulty in becoming acclimated than he would in any other State in the Union. The humidity, although not as dense as in England, is nevertheless apparent, and in this respect is very similar to the climate of England. There is more snow in winter, and this is a great advantage, as a protection to wheat and other crops that remain in the ground all winter.

The Lumber Interest.

The great interest of Michigan, which has led to its development as an agricultural State, is its lumber manufacturing. In this she not only excels England and all old settled countries, but nearly all the States in the Union. During winter thousands and tens of thousands of hardy men are engaged in the woods, cutting down the pine and other timber trees, and sawing them into logs. These are then hauled on sleighs to the banks of streams, and when the ice thaws in the spring, the logs float down to the mills and are then sawn up into planks, boards, pickets, lath, shingles, etc., and these become merchantable, and are shipped in large quantities to distant ports. The compensation paid to men thus employed is greater than that paid to farm laborers, and many who work on their farms during the summer months reap a double harvest by lumbering in the woods in winter.

Agricultural Lands.

Land cleared of pine timber is usually sold for farming purposes at very moderate prices, and on easy terms. This furnishes another chance for cheap homesteads. On the other hand the purchaser of uncleared land has, in many instances, a profitable crop of timber on his farm before applying the ax If the locality be favorable this crop of timber will pay the cost of the land and the clearing it off. It has been the practice to burn much of the timber in order to make way for immediate crops; but now that railroads are becoming numerous, the timber is becoming valuable, and is a source of profit to the settler.

Construction of Railroads.

The construction of railroads has been going forward with great rapidity. In 1865 but 941 miles of railroad were in operation. In 1872 the number of miles of railroad in operation had increased to 3049, owned by thirty-four railroad companies. About twenty other companies are organized, with a fair prospect of doubling the railroad facilities of the State within the next seven years. Railroads in Michigan are sometimes built into the heart of dense forests, and become profitable for the conveyance of timber, as well as for passenger traffic.

The Natural Productions.

By natural productions we mean the spontaneous outgrowth of the soil, unaided by human skill. These consist of the most useful varieties of timber: white pine, spruce pine, tamarack; oak, white, red, and other varieties; ash, white, black, and mountain; maple, soft and hard; beech; hemlock; cedar, red and white; arbor vitæ, cherry, butternut, black walnut, locust, rock elm, sassafras, bass, whitewood, and numerous other valuable varieties, furnishing raw material for every description of wood-manufacture, as well as for building.

Wild fruits, such as raspberries, blackberries, cranberries, whortleberries, blueberries, wintergreenberries, and several varieties of tree fruit, are among the valuable spontaneous productions of the soil. They are gathered in large quantities and shipped to market, realizing prices nearly equal to those of cultivated fruits of similar character. Many a settler, with a family of children, who commences with nothing but his ability to labor, and his homestead, is enabled to lay in a good winter's supply of groceries and clothing for his family by gathering and marketing these fruits, before trees and vines of his own planting are productive.

Wages of Agricultural Laborers.

Agricultural laborers are paid less than any other class of laborers in Michigan, as elsewhere; but the wages paid for their labor in Michigan, will compare favorably with wages for the same kind of labor in Europe or elsewhere. Day labor is paid at prices varying from one dollar and a half to two dollars a day; which in English coin would be six to eight shillings a day. But farm labor is generally performed under monthly rates, and including board and lodging. The following is the average rate paid in Michigan, as shown by the United States census of 1870:

	AMERICAN CURRENCY.	ENGLISH CURRENCY.
Farm hands, hired for the year and boarded on the farm, per month	$20 65	£4 2*s*. 8*d*.
Day labor, without board	1 68	6 9
Day labor, with board	1 19	4 9½
Carpenters, per day, without board	2 69	10 9½
Price of board for laboring man, per week	8 86	15 5½

The English farm laborer generally receives twelve shillings a week, if a good hand. In Michigan he can earn that at day labor in two days at the above average rates.

The Cost of Living.

The cost of living in country places in Michigan, is less than in England, in the items of fuel, food (animal or vegetable), and building material. It is cheaper in England in the items of clothing, and some of the most common groceries, such as sugar, molasses, rice, raisins, spices, etc. The cost of tea and coffee is about the same in both countries, or varying but little. In the country expensive clothing are not necessary, and are only demanded as wealth and pride require compliance with the edicts of fashion.

Duration of Life.

Although Michigan has not yet done all that is necessary to secure the highest degree of health for her inhabitants, the average duration of life appears greater than in Great Britain. The following table is compiled from two sources. In the first column the figures are taken from the "Carlisle Table of Mortality," extensively used by insurance companies, the most complete we can command, showing the average duration of life of persons in England, after the ages stated; and the second column is compiled from "Statistics of Michigan," pages xcii–iii–iv–v, compiled from United States census by Dr. H. B. Baker, Secretary of the Board of Health, compiler of the census, etc.

Table showing the average duration of life, after the ages named.

AGE.	IN ENGLAND.	IN MICHIGAN.	AGE.	IN ENGLAND.	IN MICHIGAN.
0	38.72	43.79	60	14.34	15.06
1	44.68	51.61	65	11.79	12.08
5	51.25	54.80	70	9.18	9.19
10	48.82	51.34	75	7.01	7.28
15	45.00	47.46	80	5.51	5.87
20	44.46	43.72	85	4.12	4.88
25	37.86	40.37	90	3.28	4.08
30	34.34	36.62	95	3.53	3.53
35	31.00	32.82	100	2.28	3.09
40	27.61	28.96	104	0.50	2.70
45	24.46	25.24	105	....	2 62
50	21.11	21.50	110	....	1.37
55	17.58	18.12	112	....	0.50

From this table it seems that the average duration of life after every age, except the age of ninety-five, is greater in Michigan than in England, and at that age the average is equal, while subsequent figures show that a person at the age of 104 in England, is not more likely to live six months than a man at 112 is in Michigan.

Extent of Land.

The number of acres of land in the two peninsulas of Michigan may be stated in even figures at thirty-five million. According to the U. S. Census of 1870, five million acres are under actual cultivation, and five million more included in farms, but still unimproved. The estimated cash value of these farms is three hundred and ninety-eight million dollars, and the annual products are worth about eighty-two million dollars. About ten million acres more are owned by individuals who pay taxes on them, so that there yet remain fifteen million acres of land, owned by the United States, by the State, or by railroad companies, subject to entry as homestead lands, or at moderate prices and on accommodating terms, or reserved as mineral lands.

Progress of Settlement.

The following tables, compiled from the United States Census for the years named, by Dr. H. B. Baker, show how rapidly the lands of Michigan are being subdued and made into farms:

YEARS OF CENSUS.	ACRES OF LAND IN FARMS.			Land in farms. Per Cent of Unimproved to Total.
	Total.	Improved.	Unimproved.	
1850............	4,383,890	1,929,110	2,454,780	56.0
1860............	7,030,884	3,476,296	3,554,588	50.5
1870............	10,019,142	5,096,939	4,922,203	49.1

YEARS OF CENSUS.	TOTAL NO. OF FARMS	Average Size of Farms in acres of land, improved and unimproved.	NUMBER OF FARMS CONTAINING THE NUMBER OF ACRES OF IMPROVED LAND STATED BELOW.							
			Under 8.	8 to 10.	10 to 20.	20 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 and over.
1850......	34,089	129	......	......	......	......	......	......	......	......
1860......	62,422	118	......	1,549	6,608	25,480	19,679	9,080	40	3
1870......	98,786	101	184	6,763	13,170	38,795	27,687	12,175	57	5

CHARACTER OF ENGLISH AGRICULTURAL LABORERS.

Because, at the commencement of this article, we referred to one of the unfortunate weaknesses of English agricultural laborers, the tendency to spend time and money in the alehouse or village inn, it must not be inferred that, as a class, they are addicted to the vice of intemperance more than any other class in Great Britain. Such an inference would be unjust to the class we desire to benefit by this paper. The use of malt liquor, as a beverage, so prevalent in agricultural districts, although a source of much evil, socially and politically, will not compare with the use of distilled liquors in cities and towns in the production of squalid misery, pauperism, and crime. Your average agricultural laborer of England, although slow in his movements and not quick of comprehension, possesses qualities for the performance of his duties as a practical agriculturist which render him invaluable on a farm. There are at present in Michigan, very few *fair specimens* of the English agricultural laborer, and therefore it is not easy to impress upon the minds of Michigan farmers the importance of securing their laborers from England. Some idea of the character under consideration can however be arrived at by considering:

I.—His Physical Strength.

No class of men can be found with such firm muscular development, full chests, and healthy, vigorous frames. There may be larger men than those of some of the eastern and southern counties, but in Yorkshire, even in size, the laborer will challenge comparison with any on the face of the globe.

II.—His Perseverance.

The patient, plodding perseverance of the English agricultural laborer is proverbial. He does nothing from mere impulse, but he works steadily, quietly, and perseveringly until the day's work is done, and he leisurely returns to his home. He can not be hurried, but he will do far more work and do it much more completely than a man of more impulsive temperament. It is plodding perseverance that tells on farm work.

III.—His Love of Home.

The love of home.

This is a strong characteristic in the English laborer, and is a principal reason why so few leave their native land and emigrate to America. It is a passion which holds them during their whole lives to the parish in which they were born, seldom removing to any other portion of the county, or to any other county. This peculiarity, in a measure, accounts for the local distinctions in the dialect of each county which are kept up from generation to generation.

Desirable for Michigan.

The English agricultural laborer, then, is a strong, steady, persevering man; his sense of honor and his honesty are unquestionable, and were he placed in circumstances where his children would secure a proper education, he would become the progenitor of an intelligent as well as useful class of citizens.

Why He Lacks Intelligence.

There are many reasons why the agricultural laborer of England is not as intelligent as the mechanic of the same country. The perpetual labor to which he is necessarily subject, to keep his family from want and destitution, dulls his intellect, and circumscribes his mental power. It is the natural tendency of excessive physical labor, always, to blunt the intellect, and inasmuch as the peasantry of England have been practically excluded from the privileges of schools for many generations, it is not wonderful that so few can read or write, or that, as a class, so few powerful intellects are found among them. That the institutions of Michigan would have a good effect on the English laborer and his family, we have ample proof.

How an English Laborer Succeeded in Michigan.

One instance, of many, we will relate:

Mr. Thomas Petty is a Yorkshireman, who can neither read nor write. About the year 1867, he came to Spring Lake, Ottawa county, and purchased, in connection with an English mechanic, who furnished a few hundred dollars, a piece of wild land on the north side of what was known as "Hammond's Bayou," an arm of the beautiful Spring Lake. The most valuable timber had been taken off, and the land was consequently purchased at a moderate price. Mr. Petty went to work, cleared it of stumps and grubs, and planted several thousand peach trees, grapevines, and some other fruits. These he has since attended to almost exclusively himself, only hiring help for a few weeks at the busy season. The site was well selected, having a fine elevation, with a gradual slope to the lake. His orchard and vineyard now rivals and even excels in productiveness and culture numerous orchards and vineyards of that noted fruit region, although nearly all the other fruit-growers are men of education as well as culture, and have studied the books industriously on all theories of orchard and vineyard management.

A Premium Orchard and Vineyard.

Mr. Petty has taken first premiums at the Horticultural fairs for his fruit, and on his vineyard and orchard, in comparison with the vineyards and orchards of similar age in that region, where the competition is quite sharp. It is not probable that twenty thousand dollars would tempt Mr. Petty to part with his place. During a recent interview, Mr. Petty stated that so abundant was his annual production of grapes, he should consider his vineyard profitable if he only realized three cents a pound for his crop. And the appearance of the vines, laden with fruit, fully justified his remark.

Here is an instance where a man, without even the rudiments of even an elementary education, comes from the bleak moors of Yorkshire, where families live in stone huts scarcely worthy the name of cottages, and these not their own, without comfort, without garden, or any other surroundings of taste or culture, and, in five years, converts a portion of our Michigan wilderness into a productive and beautiful fruit-farm, with a well and tastefully furnished cottage, in the parlor of which we noticed a first-class piano, over which hung the life size portrait, painted in oil, of a beautiful young lady, by Orchardson, an original and excellent likeness of Mr. Petty's eldest daughter. The cottage is located near the lake, commanding a view of a landscape of great natural beauty; just such a home, in fact, as secures the best possible influence on the family circle.

Room for More.

There are yet thousands of sites in Michigan where similar homes can be reared. They only await the hand of plodding industry, such as is now struggling against want in England, and with only poverty sure in the future, on a pittance of ten or twelve shillings a week. Michigan and the United States can well afford to give such sites to secure such citizens. And they can be transferred from their homes of want in England to homes of plenty in Michigan, at about fifty dollars a head.

INVITATION TO MICHIGAN.

In his recent address on the occasion of laying the Corner Stone of the New State Capitol, Hon. William A. Howard pronounced the following eloquent invitation to Michigan, covering a broad hospitality with ample munificence:

"We are told upon the highest authority that '*The powers* that be are ordained of God.' And hence we may conclude, without presumption, that He who made the world and all things therein, He who formed this Peninsula, with its productive power and its hidden treasures, wills that it should be not only the abode of His creatures, but the seat of a great, prosperous, and free State. All our physical development for the 37 years; all our increase of wealth; all the unfolding of our vast natural resources, are but the adornment of the Peninsula that she may the more effectively woo the Heavenly Pilgrim. As a bride adorns herself for her husband, so every successive day she puts on still more beautiful garments, and beckons the Divinely appointed State to her bower. Her vast agricultural treasures, that block up the thoroughfares and crowd the marts of the world, all utter their voice, all say 'Come.' Her hundreds of thousands of tons of iron ore that annually come forth from their mountain seat and leap into all the channels of the commerce of the world say 'Come.' Her rich and extensive copper mines say 'Come.' Her forests of boundless wealth wave their welcome and say 'Come.' From year to year she displays her jewels, ever growing in brightness, and says with increased persuasiveness, '*Si quæris Peninsulam amœnam circumspice.*'* The evidences are everywhere abundant that Providence designed and fitted this Peninsula to be the abode of an industrious and happy people, the place of an advanced civilization, the seat of a great, prosperous, independent, and free State."

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* The motto on the seal of the State: If you would behold a beautiful Peninsula: look around.

YIELD OF CROPS, 1872.

◆

COUNTIES.	Hay, tons.	Wheat, bush.	Barley, bush.	Oats, bush.	Rye, bush.	Buckwheat, bush.	Indian Corn, bush.	Potatoes, bush.	Apples, bush.	Peaches, bush.	Hops, lbs.	Turnips, bush.	Beets, bush.	Carrots, bush.	Onions, bush.
Allegan	1¼	14	25	30	....	18	30	50	100	....	....	....	....	....	....
Branch	1¼	18	20	30	15	15	44	54	100	....	400	150	....	....	....
Charlevoix	1	20	35	20	25	10	15	150	....	....	....	300	600	....	....
Clinton	1⅓	15	25	35	....	25	40	30	100	....	300	300	1600	....	300
Eaton	....	17	25	35	....	10	35	10	....	....	....	60	....	....	....
Emmet	1	30	30	50	30	20	40	....	....	....	....	300	....	....	....
Genesee	1	8	30	40	....	15	40	40	100	....	....	....	....	....	....
Gratiot	1¼	13	....	30	....	20	48	....	....	....	....	....	....	....	....
Gd. Traverse	1⅓	18	27	27	18	27	42	175	....	....	1600	500	500	....	300
Hillsdale	1¼	18	10	35	....	30	70	50	100	....	....	300	....	....	250
Huron	1⅓	20	20	35	20	30	35	100	....	....	....	400	1000	....	200
Ionia	2	15	25	30	....	20	75	175	....	....	....	400	....	....	....
Isabella	1¼	14	20	30	18	20	35	60	100	....	....	140	150	....	150
Livingston	1¼	17	24	30	14	16	45	56	....	....	....	....	....	....	....
Lapeer	1	12	18	25	....	25	30	50	....	....	....	....	....	....	....
Leelanaw	1	15	30	25	15	20	35	150	....	....	....	300	300	....	300
Mason	1⅓	15	....	40	12	60	20	100	....	....	....	....	....	....	300
Manistee	1	25	....	30	20	15	30	125	....	....	....	....	....	....	....
Macomb	1¼	13	25	35	....	22	45	15	....	....	700	400	550	....	200
Menominee	1	....	....	40	....	....	....	200	....	....	....	400	....	....	....
Missaukee	1⅓	15	....	45	....	....	75	180	....	....	....	300	....	....	100
Montcalm	1	10	20	25	....	16	30	100	....	....	....	125	....	....	....
Oakland	1	10	25	30	12	20	35	20	....	....	300	300	500	....	300
Kalkaska	1⅓	25	20	30	15	15	30	150	....	....	....	250	....	....	....
Oceana	1⅓	20	20	40	15	10	30	150	....	....	....	300	....	....	....
Presque Isle	2⅓	45	33	42	....	....	60	160	....	....	....	450	....	....	....
Shiawassee	1⅓	10	30	35	....	12	40	30	100	....	....	....	....	....	....
St. Clair	1⅓	15	40	50	25	35	40	....	....	....	....	350	....	35	....
Tuscola	1⅓	15	....	40	....	20	40	100	....	....	....	....	....	....	....
Van Buren	1⅓	20	....	30	....	20	40	40	....	150	....	400	....	....	300
Wayne	1⅓	12	....	35	20	25	70	....	....	....	....	70	....	....	50
Washtenaw	1¼	10	18	20	....	8	75	....	....	....	....	250	....	....	....

REPORTS FROM COUNTY AGRICULTURAL SOCIETIES.

BARRY COUNTY.

At the Annual Fair held on the grounds of the Society, October 2d, 3d, and 4th, the number of membership tickets issued were 537; number of entries 720; amount of premiums awarded $369.50. The officers for 1873 are:

THOMAS ALTOFT, *President.*

JOHN M. NEVINES, *Secretary.*

GENESEE COUNTY.

TWENTY-THIRD ANNUAL REPORT OF THE BOARD OF MANAGEMENT OF THE GENESEE COUNTY AGRICULTURAL SOCIETY.

(Adopted at the Annual Meeting of the Society held January 8th, 1873.)

In accordance with annual custom, for now almost a quarter of a century, and as required by your by-laws, this Board beg to submit, for your consideration, their report on the general condition of the Agriculture, Horticulture, and Manufactures of Genesee county, for the year 1872.

In our report a year ago we had occasion to comment upon a year of most remarkable drought, and its consequences upon the products of the farm. Although not to so extraordinary a degree as was presented in 1871, the seasons of 1872 have been similarly characterized; and while the inhabitants in some other parts of the world have had floods to contend with, the soil of our country is suffering to-day from the deficiency of moisture incident to the succession of a second year of uncommon dryness, commencing without the usual spring rains, and continuing month after month, until the winter closed in without the thirsty soil receiving the copious showers to which our climate is ordinarily accustomed in the autumn season. Two years of such protracted drought could not fail to produce serious effects; and we see them in the failure of our wells, the emptiness of our cisterns, the lowness of our streams, and the cramping or disability of our water mills, in their capacity to work.

As in 1871, you will remember that the past spring opened very favorably for the farmer, the ground generally working up very mellow, and all the circumstances tending to induce the planting of a large surface of our usual spring crops, which came up evenly and started with promise of the best results. As we have heretofore observed on previous occasions, and would again enforce upon your attention, the crops planted earliest were the most successful in their development and products. On the whole, the expectations of farmers were greatly encouraged by the conditions of the opening season, notwithstanding an unpromising appearance in the wheat fields; and an unusually large amount of oats and corn was planted under the most favorable auspices. But the want of sufficient rain pinched the development and growth of the plants, and although good crops came to maturity, the aggregate was undoubtedly much diminished from this cause. The limited amount of rain-fall we did experience was quite unequal in its distribution, some portions of the county being much more favored, in that respect, than others, and the crops in those districts were affected accordingly. But, considering the circumstances, all the spring-sown staples matured well, there being no frost to damage the corn until it had become fully ripe. For haying and harvesting operations, the dry weather was, of course, eminently suited, and all crops were saved in good condition.

FIELD CROPS.

Wheat.—Owing to the drought of the fall of 1871, the usual breadth of wheat for this county was not sown. What was put in looked very sickly when spring opened, and, as the season advanced, made slow progress in its growth; and a few showers before harvest time, just when the plant was in its most susceptible condition to be so affected, caused rust. In consequence the crop was almost a failure; the quantity being light, and quality but second rate. We doubt if the average yield of wheat was more than eight bushels per acre.

Oats.—For reasons already suggested, and the failure to put in the usual quantity of wheat, more than the average acreage was sown with oats. They did well, producing a good crop; as usual, those sown the earliest giving the best results. The yield averaged about forty bushels to the acre. The quality was excellent.

Corn.—The same causes operated to also increase the quantity of land planted with corn; and the late period to which frosts held off, enabled it to mature under favorable circumstances. A good yield of good corn was thus realized. The average we should place at about forty bushels to the acre.

Barley.—Barley does not seem to be a favorite crop in Genesee county, and comparatively few farmers raise it, although, under suitable conditions of soil and season, it is a profitable crop to cultivate. About thirty bushels to the acre would probably be near the average.

Hay and Grass.—The hay crop, though not a heavy one, was admirable in its quality, its nutritious properties and capability to sustain stock in good order being seldom surpassed. The average yield of the meadows was about one ton of hay to the acre, saved in the finest condition. The same general remarks will apply to clover hay; but clover seed was a light crop, of fair quality, the deficiency being caused by the dry weather. Pasturage was good,—much better than that of the year previous.

Potatoes.—The breadth of potatoes planted was much less than that of former years, the failure of the previous crop and the ravages of the potato bug deterring farmers from the risk of devoting the customary amount of land to this esculent. Notice, however, is being attracted to several new varieties—such as Early Rose, Late Rose, Peerless, Harrison, and others—which have generally done much better than the old kinds which have long been esteemed as standards; but which seem to be gradually losing the power to reproduce in our soil their best properties as formerly known. The quality of the potato this year has been good, though the yield has been much decreased by the operations of the bug. We estimate it at forty bushels to the acre on an average.

Buckwheat.—Of buckwheat there was about the usual breadth sown, giving a good yield of fair quality.

Root Crops.—The limited supply and high cost of farm help still operate to prevent attention being given to the raising of root crops to any great extent, as food for stock. Where they have been cultivated the product was good.

FRUIT.

The county was favored with an unusual abundance of excellent apples, in almost all the orchards; and a fair crop of most other fruits raised here, such as pears, plums, cherries, etc.,—excepting peaches, which were an entire failure.

STOCK.

Blooded Cattle.—If we except the Hereford herds of the Crapo stock, selections from which took first premiums over all competitors from other States, as well as our own, at the great fair of the Northern Union Society in Grand Rapids, the breeding animals of the best full-blooded cattle have become very deficient in our county,—a deficiency that cannot too soon be remedied. We strongly recommend that more attention be given to this important interest, believing that it will be found a good paying investment.

Horses.—Genesee County never was better supplied with fine horses. Unlike the horned cattle, the interest in this class of stock increases rather than diminishes, and we can point with pride to the very many superior horses kept by nearly all classes of our citizens. In common with those of the rest of the country, our horses were affected with the universal epidemic which prevailed over the continent; but usually the malady did not visit them heavily, and we have heard of but a very few fatal cases.

Sheep and Wool.—The appreciating value of wool has given a fresh impetus to the rising interest felt in sheep culture We believe there are no better flocks of fine-wooled sheep to be found in the State than Genesee County can exhibit; and the flocks of middle and coarse wools are increasing in numbers and quality every year. The wool clip was a fair one. Most of the large sheep-farmers declined to sell their clip at the usual time for marketing wool, feeling confident that its value would increase over the prices then offered, before the close of the year. In this they were not disappointed. The bulk of the clip of this county was thus held until the month of November, about which time it was sold at an average of fifty-eight cents.

Swine.—In swine, the smaller breeds are fast superseding the large ones, with the majority of farmers. Suffolk, Essex, Berkshire, and their crosses, seem to be the favorites with those who bestow most attention upon the improvement of this line of stock, the reasons for this preference, set forth in former reports of this Board, still commending themselves to approval. The quantity of pork marketed has been and continues to be large, and the quality good; the average weight of the same breeds being considerably over that of last year.

MANUFACTURES.

The manufacturing interests of the county exhibit no new features; but those existing continue to increase in extent, value, and importance.

TRANSACTIONS.

In the transactions of the year there was nothing of especial note. At the twenty-second annual meeting, held on the second Wednesday of January, 1872, you elected the following officers:

President—Charles Pettis of Davison.

Secretary—F. H. Rankin of city of Flint.

Treasurer—Oren Stone of city of Flint.

Directors—To fill vacancy for one year (caused by the election of Charles Pettis president)—H. G. Conger of Burton; for two years each—L. P. Andrews of city of Flint; E. W. Rising of Richfield; Y. E. Benton of Fenton; F. H. Kellicut of Clayton.

The board of management met on the 13th of March for revision of the premium list, and completed the same on the 1st of June. Numerous additions and modifications were made in the premiums offered, so as to extend the range of the list as far as the financial liabilities of the Society at that time would seem to admit.

There is no matter to which this Board gives more careful consideration than the selection of the original committees of judges appointed to award the premiums at the fair, and no part of our duty which presents more difficulties in arriving at satisfactory final results. In making the appointment we have to consider: 1. His being well qualified to judge in the particular class to which he is appointed. 2. The probabilities of his being himself a competitor in that class, which would exclude him, under our by-laws, from being a judge in the class where he competes. 3. A due distribution of the appointment throughout the county, as far as practicable, so as not to seem to favor any sections above others. 4. A pervading indisposition to serve as such judges, partly from unwillingness to spare the time it ties up the member from the general enjoyment of the occasion, partly from the proneness of unsuccessful competitors to find fault with the decisions of the judges when made, and to charge them with partiality. There are in the neighborhood of 120 such appointments to be made, and in making them, we have thus to avoid, if possible, unqualified persons, competitors, the location of the appointees too near together, and the appointment of those likely to refuse to act. Having, with all these considerations in mind in each case, completed our appointments, the usual experience is that not over one-third of the judges selected will be present to serve. Then, the only resource of this Board is to fill the vacancies to the best of their judgment, from such persons as they can find upon the grounds willing to act. If those who think they have reason sometimes to take exception to the judges would reflect a little upon these obstacles, we think they would be less inclined to fault-finding.

The Annual Fair held on the 1st, 2d, 3d, and 4th of October was well attended, and very successful,—except on Wednesday, the second day, which was wet and disagreeable, the weather was all that could be wished for. In several of the classes of exhibition, as working oxen, sheep, swine, fruit, vegetables, carriages, farm implements, and others, the display was never excelled, and in some of them has not heretofore been equalled in this county. The show of handsome carriages, buggies, cutters, etc., manufactured in Flint, was so extensive that we found it necessary to erect a separate shed for their accommodation. The exhibition of agricultural implements was also unusually large and complete.

The awards of the judges, upon review, were all confirmed, and where they recommended discretionary premiums we have conferred them upon all articles eligible to receive premiums under the constitution and by-laws of the society. The awards and reports of the committees of judges have been published in full.

For a statement of receipts and disbursements, and financial condition of the society, we would refer you to the report of the treasurer and of the finance committee.

All of which is respectfully submitted for the Board of Management.

F. H. RANKIN, *Secretary.*

Flint, December 31, 1872.

HILLSDALE COUNTY.

To the State Board of Agriculture for Michigan:

GENTLEMEN—In presenting the twenty-second Annual Report of the Hillsdale County Agricultural Society, for the year 1872, we are again reminded of the fleetness of time, the brevity of life, and the uncertainty of human calculations. Since our last report, many of the strong pillars of advancing science in agriculture have taught their last lessons in the ennobling work, and it is left for others to carry forward the interests they so nobly begun.

It is a pleasure to speak of home interests as being in a prosperous condition, even if they are not as elevated as we would desire to see them. The steady, every-day progress in life is in the end the sure victor. The history of agriculture in the centuries past show it a plant of slow growth, subject to the vicissitudes of the elements, and the freaks and fancies of man.

It is pleasant for us to contrast the present with the short period of thirty years past, although it spans a chasm in our history, and in the history of the whole country, inimical to all the drawbacks of civilization, refinement, and high progress in the arts and sciences; adverse to the advancement of the husbandman in numerous ways; yet, with all these impediments, great and noble results have been reached, and stand as monuments, attesting the intelligence and energy of our people. In no section is this more clearly demonstrated than in our own Peninsular State. The progress made in the last thirty years in developing her agricultural, mineral, and mechanical resources, challenge comparison. The intelligence of her people, with her facilities for spreading it to the rising generation, are proverbial.

Her university, colleges, academies, seminaries, and union schools, with her noble experimental college and farm, all speak her greatness now and in the future.

Our county of Hillsdale claims an interest in these institutions. From her infancy she has been the advocate and supporter of all,—in her manhood she endows and supports the second of the number. And, being of the first in the State to put our union school system into successful practice, it is little wonder that her people are found ready for every prospective improvement. Our greatest want is a higher intellectual development of our tillers of the soil, in their favorite pursuit. Many, very many, were educated, "if at all," in the old school; they do as their fathers did before them, and feel they have done all things well, when in fact they have been far behind in originating and carrying forward measures for the advancement of science, even in their own agricultural interests.

Our adaptations in soil and climate require a mixed course of agriculture.

Destitute of the large motive power possessed by many other counties, and without the mineral products of a vast portion of the State, we are brought to the level of making our living from the products of the soil, our mechanical productions being auxilliary thereto.

From the three years of excessive drought with which we have been visited, reducing our crops twenty-five per cent, our people have improved the opportunity of reclaiming the low and wet places of their farms, by ditching and under-draining to a large extent; and what seemed a calamity will, in the end, prove a permanent good to many. The great improvement in agricultural machinery, the better understanding of many farmers as to the constituents of their soil, and its wants for plant growth, is having a happy bearing on the return crops. Our increase for the last five years has been gradual and steady,—not less than twenty-five per cent to our best cultivators.

Our wheat crop for the year, although sown under very unfavorable circumstances, produced an average of eighteen bushels per acre. Our corn crop, the best harvested for five years, about seventy bushels of ears to the acre. Our grass and oats were very medium, owing to the long continued drought. Potatoes were nearly a failure; the drought, with the ravages of the potato beetle, was more than they could endure. Our fruit crop was a full average one, not very profitable in a commercial sense, owing to the universality of it through the country. It should bring no discouragement to the cultivators, but stimulate them to measures of working it up more effectually.

In stock we are making steady progress. Our Short-horn breeders are meeting with ready sales at remunerative prices. Some of our herds have an enviable reputation at home and abroad. Fine grades are fast taking the place of natives with most of our farmers.

Our horses compare favorably with other portions of the State; we furnish annually large numbers for the eastern markets, of good quality. An advance in higher blood would elevate quality and price materially.

In sheep we stand about as last year; quality very good, but our flocks are below standard in number.

In swine farmers will differ in judgment; some covet the small, as Essex, or Berkshire, others the large, like Poland, or

Magie, while others, regardless of cost or quality, will be governed by color, and satisfy their wants with the Chester Whites, or Byfields. We are pleased to report the classes named as constituting the swine element of the county, and in our judgment a great improvement over the past. The poultry interests of the county are large. Since facilities have opened for quick transportation to eastern markets, the raising of poultry and eggs has assumed a definite form, and it will not be an over-estimate to place the returns at fifty thousand dollars a year.

Our mechanical interests are growing. Since our last report there has been added to the same at Hillsdale a chair factory of large capacity, employing a hundred and fifty hands or more. At Reading two large interests have sprung up, one for manufacturing the Colby wringer, the other for manufacturing chairs and house implements of all kinds constructed of wood. These are in successful operation, employing some two hundred hands, and creating a home market for much of the timber and lumber with which the south part of the county abounds. At Jonesville they have a cotton factory of large dimensions nearly completed, which will give employment to a hundred or more persons. These, with the establishments heretofore reported, will show an investment of nearly a million dollars in manufacturing, besides employment to nearly two thousand operatives.

Our fair was held on the first, second, third, and fourth days of October. Most of the departments were well filled, and the exhibition as a whole gave very general satisfaction. Improvement was a marked feature in almost every class, over former years. Our entries were not quite as large as in some years past; yet the awards were larger than ever before. This is attributable to the fact of only the better quality of productions being presented for exhibition. Another fact is very clearly demonstrated, and that is, a poor animal, or an inferior article or production, presented before a discerning public, meets with no approbation, and they manifest their judgment in so many ways that the exhibitor may readily read his fate without awaiting the decision of judges.

Another feature of a successful exhibition, and which must be carefully guarded by those having it in charge, is to have your premium list so equalized between the several classes that no partiality shall be detected by exhibitors or the public. This gives confidence, and brings a liberal and healthy rivalry for the best. The following table gives the number of entries in each department, the number of awards in each, and the amount awarded:

DEPARTMENT.	No. Entries.	No. Awards.	Amount.
Cattle	50	82	$144 50
Horses	185	60	399 50
Sheep	50 pens.	38 pens.	100 00
Swine	48 "	28 "	98 00
Poultry	40 coops	28 coops	10 50
Carriages	19	10	33 00
Farm and barn Implements	178	31	29 50
House Implements	85	18	14 00
Leather	16	15	19 50
Grain and Seeds	29	17	14 00
Vegetables	96	62	26 50
Conserve products	70	34	22 50
Domestics	54	29	24 00
Needle-work	85	46	38 00
Millinery	7	7	8 75
Paintings	18	7	15 00
Musical	6	4	8 00
Minerals and Shells	9	9	15 00
Natural Flowers	95	44	52 00
Apples	229	59	28 00
P. P. P. and Grapes	132	54	27 00
Total	1,276	627	$1,111 75

From the above we glean the fact that about fifty per cent of the entries drew premiums, and the average amount to each bears relatively and quite equally to the value of the article exhibited, with the expense and trouble of putting it on exhibition.

Financially the fair was a success, the gross receipts being $3,675 95.

Our grounds were deficient in not having a good track. By an arrangement with the Hillsdale Horse Association whereby they contribute $870 00, and a donation from the city of Hillsdale of $300, we have built a new track in all respects first class; also, a grand stand 24 by 80 feet, at a cost, for both, of $2,500 00. Our buildings are of wood, permanently built, of good architectural design, and well adapted to their several purposes. They have cost us as follows:

Floral hall	$4,000 00
Mechanics' and agricultural hall	3,000 00
Dining hall	2,000 00
Offices and residence of keeper	1,200 00
Cattle shed or barn	900 00
Horse stables	500 00
Grand stand	900 00
Judge's stand	150 00
Ticket office for dining hall	200 00
Out-buildings	300 00
Stationary hog-pens	100 00
Portable sheep-pens	100 00
Lands, grading, and fencing	4,650 00
Making a total of	$18,000 00

Our present indebtedness is $4.375 00.

The officers for the ensuing year are as follows:

President—W. J. Barnard, Litchfield.

Vice President—Chas. R. Coryell, P. O. Jonesville.

Secretary—F. M. Holloway, Hillsdale.

Treasurer—Geo. C. Munro, Jonesville.

All of which is respectfully submitted.

ROBERT WORDEN, *President*.

F. M. Holloway, *Secretary*.

IONIA COUNTY.

H. C. Sessions, Esq., assistant secretary of the Society, writes:

The cold and dry fall of 1871 checked the growth of winter wheat, causing many late crops, which were badly injured by the *midge*; while the early crops were prevented from filling by the dry hot weather of the early summer; thus reducing the average yield of wheat to fifteen bushels per acre. In 1871 the average was reported to be twenty bushels per acre.

Large quantities of strawberries are grown in this vicinity; "Wilson's Albany" and the "Agriculturist" being the principal varieties.

The soil of the county is varied, but mostly a rich and heavy gravelly loam; it varies from the heaviest timbered land to a very light sandy plain.

The climate is mild; we generally escape late frosts in the spring, and early frosts in the fall.

The most troublesome insects are the curculio, apple tree borer, and midge.

Agriculture generally consists of hay, wheat, oats, Indian corn, buckwheat, potatoes, fruit, and stock-raising. The two latter branches of agriculture are gaining more attention than formerly. There are many fine herds of cattle and sheep in the county, also excellent orchards and vineyards.

The annual exhibition of the Society was held at Ionia, September 25, 26, and 27, and was very successful.

In the stock department the display of cattle was very good; some fine herds of fat cattle were shown by A. F. Kelsey and Jerry Spaulding.

All the departments were good, but not as good as they would be if the farmers would only bring the results of their toil and show them.

The Society is now in a very prosperous condition. Receipts for this year about $1,650. Expenditures $1,468. $750 was paid for premiums.

INGHAM COUNTY.

The Central Michigan Agricultural Society comprises Ingham, Clinton, Eaton, Livingston, and Shiawassee counties. The annual fair is held in Lansing, on one of the most beautiful pieces of ground, for such a purpose, in the State. The executive committee is composed of two members from each county.

The following are the officers for 1873:

President—L. B. Potter, of Lansing.

Secretary—B. B. Baker, of Lansing.

Treasurer—J. J. Bush, of Lansing.

The Ingham County Agricultural Society holds its annual fair at Mason, the county seat.

It has pleasant grounds close to the village. The fair for 1872 was very successful in every way.

The officers for 1873 are:

President—Wm. W. Root, Mason.

Secretary—Geo. W. Bristol, Mason.

Treasurer—Thaddeus Densmore, Mason.

KENT COUNTY.

The Kent County Agricultural Society has held no fair for the last two years, the Northern Michigan Agricultural and Mechanical Society having accepted the grounds during that time, holding their first and second annual fairs in connection with the State Pomological Society, thus forming what is familiarly known as the "Great Union Fair."

The citizens of Grand Rapids have contributed liberally towards the improvement of the fair grounds in order to accommodate the N. M. A. & M. Society.

The improvements upon the grounds consist of a fine art hall, in shape of a Grecian cross, size 40x120. This building has been erected at a cost of $5,500, and is not fully completed;

the length of the gallery of which is 480 feet; height of central dome 82 feet, the same being covered with a shingle roof, and the entire building neatly painted.

The Pomological hall is a neat frame structure, size 44x120 feet, shingle roof, with sky-lights, and is well ventilated. There is also a sufficient number of side windows to make the room light and airy. This hall is also neatly painted.

The Manufacturers' hall is constructed similar to the Pomological hall; size 40x120 feet, and is also well painted. All of the above mentioned buildings rest upon good substantial stone foundation walls, and are built with a view to durability.

The Vegetable hall is a building 24x100, has also a shingle roof, and is intended for the exhibition of agricultural productions.

A second Manufacturers' hall is a substantial structure, for exhibiting machinery; the size of this building is 40x104, with a solid two inch plank floor.

The Grand Stand is an elaborate structure resting upon solid stone piers; length of building 180 feet; and has a shingle roof; this building will comfortably accommodate 2,000 people with seats.

There is also a building for the exhibition of Poultry, size 24x80 feet; and between 550 and 600 stalls for horses and cattle, 200 of which are close box stalls. The office buildings at the main entrance are 18x120, two stories high; the lower story is divided into offices for President, Secretary, and Treasurer, the upper story being used for a ladies' sitting-room.

There are also two buildings, each 24x100, with shingle roofs, for swine and sheep, also one carriage shed 25x108.

The grounds are well watered, there being no less than ten wells of the best of water.

The cost of these various improvements exceed $20,000.

The grounds comprise 34 acres, beautifully located, easy of access, and convenient to the city of Grand Rapids. There is an excellent one-half mile track, which has been greatly improved during the past season, under the supervision of the Grand Rapids Driving Park Association.

The improvements upon the fair grounds are unsurpassed, perhaps unequalled, by any in the West. Thirty-six acres additional ground, adjoining the south side, has been purchased, and will be inclosed with the fair grounds the coming season. The Society is bearing an indebtedness of $4,125, to be paid in one and two years.

EDWIN A. BURLINGAME,
Secretary Kent County Agr'l Society.

ISABELLA COUNTY.

The soil of this county is good, but its capacity is undeveloped to a great extent. About one-third of the county is comprised in the Indian reservation, of which but small portions are cultivated. The county has no agricultural society.

JACKSON COUNTY.

The following are the officers of the Agricultural Society of this county, for 1873:

President—Hon. John F. Drew, Rives.
Secretary—R. D. Knowles, Jackson.
Treasurer—Chester Warriner, Jackson.

LAPEER COUNTY.

The year 1872 has not been a favorable one for farmers in this county. The wheat sown in the fall of 1872 did not grow well, and the spring being unfavorable, the yield was small and the grain of poor quality. Most other crops are light, or low in price. Sheep are not now kept on many farms, so that the income from wool is not great. Pork is low; also beef. Money is scarce; taxes are high.

A large portion of the county is unimproved, being pine forests, and tracts from which the pine has been removed, and now grown over with brush and briars. It is the opinion of many good farmers that, valuable as the pine is, the county will be more prosperous when the pine is used and the land improved.

There is but little interest taken in the improvement of live stock. Occasionally a thorough-bred animal is brought into the county, and a few small herds of thorough-bred cattle are kept. There is, however, but little encouragement in breeding such, as there is but little demand for them, and consequently slow sales.

The greatest improvement is in cattle and swine, sheep being at a stand-still, if not on the decline.

The two railroads running through the county and crossing at Lapeer City, will undoubtedly help to improve the lands in the county much faster than heretofore.

Owing to the D. & B. C. R. R. track passing through the leased grounds of the Society, it was necessary to move the buildings to another place. The Society have a contract for the purchase of twenty acres which had been leased, fenced, and a fine track graded by the Driving-Park Association, making an arrangement to use the grounds together. The old buildings that were of use were removed, some new ones erected, and the Society now has very good facilities for exhibition.

The show at the annual fair was in all respects good. Mr. G. F. Wastell of Port Huron, and John Leissiter and E. M. McGonnegle of Oakland, and Samuel Gibbons of Lapeer, showed fine herds of Short-horns; E. J. White and R. G. Hart, Devons, and a herd of Galloways by R. G. Hart,—the first introduced in this county;—a fine lot of long-wool sheep by Mr. Wastell.

Berkshire swine were shown by Mr. Wastell, R. G. Hart, J. S. Grey, and I. H. Butterfield, Jr.

A fine show of farm implements by H. A. Currier of Almont, including a steam engine by A. C. Bruce of Lapeer, as home manufactures.

Although the exhibition was successful and the receipts good, yet the directors notice with regret the lack of interest among the farmers in the affairs of the Society. They find it difficult to get competent judges who will serve, and hear many complaints about the paltry twenty-five cents which it takes to gain admission to the grounds.

The receipts for 1872 are as follows:

At annual fair, including entry fees for speed	$1,243 00

Nothing has been received from the county for two years past.

EXPENSES.

Premiums, including speed trials	$937 50
Other expenses	288 60
	$1,226 10

I. H. BUTTERFIELD, Jr.,
Secretary, Lapeer.

MACOMB COUNTY.

The Twenty-third Annual Fair of the Macomb County Agricultural Society was held at Romeo, Wednesday, Thursday, and Friday, Oct. 2d, 3d, and 4th, 1872.

By virtue of a resolution adopted in 1869, the citizens of the border counties, viz., Oakland, Lapeer, and St. Clair, are entitled to all the privileges granted at our fairs to the citizens of our own county, provided they reciprocate. Many citizens in the first two named counties have, during the past three years, availed themselves of the offer, and been prominent competitors at our exhibitions, as well as members of awarding committees.

The constitution of our Society provides that any person, resident of this State, who shall pay into the treasury *ten dollars* or more, in one payment, may constitute himself or any person he shall designate (one person for each ten dollars), a member of the Society for life, to whom shall be issued a certificate of membership, entitling himself, wife, and minor children to free admission at the annual fairs, and all the privileges of an annual member during his life, and the same to extend to his widow and minor children after his death.

The fair of the present year equalled, perhaps, in importance and interest, that of any held since the organization of the Society. The weather the last two days was all that could be desired, the attendance large, and the display in all departments good,—in some never before surpassed. Floral, Fruit, and Vegetable Halls were especially attractive. The mechanical department was made a very prominent feature of the exhibition. The farm implements displayed reflected great credit on our home manufacturers.

Total number of entries, 866; total amount of premiums offered, $1,435 50; total amount of premiums awarded, $1,005 00.

The financial condition of the Society, as shown by the Treasurer's report, submitted at the annual meeting of the Executive Board, held on the 12th inst., is as follows:

RECEIPTS.

Amount received from ex-Treasurer Dec. 14, 1871..	$101 11
Amount received at annual fair 1872 (sale of tickets),.	1,148 15
Amount received from Secretary, 1872 (entry fees),	137 20
Amount received from Romeo subscription list....	116 00
Amount received from refreshment stand (license).	38 00
Amount received from grand stand................	20 16
	$1,560 62

EXPENDITURES.

Amount of treasury orders of 1872 (redeemed)....	$1,308 02
Amount of treasury orders of 1871 (redeemed)....	163 94
Amount of interest money paid..................	3 84
Amount on hand Dec. 12, 1872..................	84 82
	$1,560 62

The constitution provides that the annual meeting of the Society shall occur on the second Thursday in December of each year, for the election of officers and seven directors, who shall serve for *two* years.

At the meeting held on the 12th inst., the following named persons were elected as officers for the ensuing year:

President—Silas A. Colby, Bruce.

Vice President—Loren Andrus, Washington.

Secretary—Daniel B. Briggs, Romeo.

Treasurer—Andrew J. Sikes, Romeo.

The lease of the grounds upon which the Society has held its fairs during the past *ten* (10) years, expires with the present year; and it is now a serious question with those having a lively interest in the welfare of the Society whether a permanent location shall be secured, or the system of "rotation" be adopted. By a resolution passed at the recent annual meeting, the Executive Board (comprising the officers and directors), is fully authorized to locate and establish the annual fairs of the Society at such place, and upon such terms, as may be deemed most expedient and advisable, by purchase of grounds, by lease, or otherwise.

MASON COUNTY.

Charles T. Sawyer, Esq., of Lincoln, county clerk, writes that fruits of all kinds, so far, are perfectly successful, especially plums and apples, no curculio or worms having yet made their appearance. Vegetables also are very satisfactory.

The soil and climate so far as tried seems better adapted to the raising of fruits and vegetables, than grain. All strong grasses grow well.

MENOMINEE COUNTY.

E. S. Ingalls, Esq., of Menominee, writes:

The soil on the pine lands is sandy and usually of little value for agricultural purposes, but on the hard-wood lands it is a clay loam with a subsoil of clay, gravel or limestone. On this soil all crops do well. The season is too short for corn, though the small eight-rowed varieties will sometimes ripen. Agriculture has made slow progress thus far, and little attention is paid to the raising of grain. Hay and potatoes pay the best, and farming is mostly confined to the raising of these crops. Timothy and clover do well; also all kinds of root crops.

Nearly all the farms in the county were burned over by the great fires of October, 1871, and many farmers had no means of planting a great breadth of land last spring, but this season has been a very favorable one, and such crops as were planted gave a large yield.

The only insect that troubled vegetation was the Colorado potato-beetle, but this has been very numerous and troublesome.

OAKLAND COUNTY.

The annual exhibition of the Agricultural Society of this county was held on the 10th, 11th, and 12th of October.

The weather was clear but exceedingly cold, and unpleasant for all operations pertaining to the fair.

All departments were well filled; the show of stock was especially excellent, and the exhibition as a whole was a decided success.

The receipts were	$3,988 80
Expenses	2,392 24
Leaving a profit of	$1,596 56

NOAH TYLER, *Secretary, Pontiac.*

OCEANA COUNTY.

The soil of this county seems specially adapted for wheat, always yielding excellent crops of the best quality. Potatoes do exceedingly well, the quantity and quality being above the average. All kinds of fruit are produced, and of the best quality. Plums and cherries have not been troubled with curculio.

PRESQUE ISLE COUNTY.

The soil of this county is apparently capable of raising very heavy crops. It consists of a dark, sandy loam with clay subsoil, very rich in calcareous deposits. The low lands have a heavy black loam, timbered with ash, elm, and cedar. The high lands are timbered with sugar maple, beach, elm, basswood, and occasionally ash and ironwood. All kinds of vegetables grow abundant crops. The county is developed to but a small extent as yet, but promises exceeding well, and seems likely to rank among the first in the State.

SHIAWASSEE COUNTY.

The Shiawassee County Agricultural Association held its thirteenth annual fair at Owosso, on the 2d, 3d, and 4th of October last. It proved to be the most satisfactory exhibition and the most successful fair, financially, ever held in this county. Every department was quite fully represented. Though this year's premium list had not been largely increased over last year, yet the premiums awarded were largely in excess of any previous year. The entries of articles for exhibition were more numerous than for any fair heretofore held, and were as follows:

Horses	279
Cattle	109
Sheep, Swine, and Poultry	104
Farm Implements, etc.	111
Fine Arts, etc.	158
Fruit, etc.	180
Vegetables, Cereals, and miscellany	263
Total entries	1,204

The receipts for membership and admission tickets amounted to $1,216 55.

Each year marks a very gratifying improvement in the stock. Mr. A. H. Byerly, and Messrs. Dewey & Stewart, all of Owosso, have of late years given much attention to the improvement of horses in this county. Messrs. D. & S. are owners of the Mambrino Stallion "Colonel Fisk," and Hambletonian Stallion "Louis Napoleon," and the following named brood mares: "Julia Drake," thoroughbred, and "Alice Stewart," "Lucy Neal," "Nelly Stewart," "Fanny Moore," as well as other fine brood mares whose pedigrees are not traced. Mr. Byerly owns the Mambrino Stallion "Mambrino Prince," the Clay Stallions "Robert S. Strader" and "Bertie Clay," as well as other fine stock. Besides the stock in these two stables, some fine specimens are owned by different ones, in different parts of the county. Considerable interest has been awakened in the minds of farmers, quite generally, as to the better breeds of horses; and the results of the care and attention to the improvements are already becoming apparent. Better grades of horses are to be found in the county, and prices are correspondingly higher; and, still better, the animals rceive more care and attention than in former years.

More care in the breeding of cattle is manifested than formerly, though for a number of years our farmers have been making improvements in the breeds of stock. There are several herds of Short-horns in the county, as well as some very fine Devons. Durhams and Devons seem to be most in request,—the former, I think, taking the lead,—while there are some other varieties of fine stock. The show of cattle at the fair exceeded that of last year, and as much interest was excited in this department as in any other on exhibition. Some farmers have specially interested themselves in the improvement of breeds, and can now show fine herds of the better varieties. The efforts of these breeders will in a few years make a decided improvement in the cattle of Shiawassee county. Indeed, the influence of the thoroughbred Durhams and Devons imported into the county is widespread and noticeable, even to casual observers, at the present time.

Compared to other years, the interest in the growth of sheep has abated. Formerly, fine-wools were mainly cultivated, while at present coarse and long wools have almost entirely excluded the fine grades; but the wool clip falls far short of a few years since, though it is now again increasing.

For two or three years considerable attention has been paid to swine. Improved breeds have been imported, and more care is taken to improve the stock of hogs in the county. This laudable endeavor is not encouraged by high prices for pork, but there appears to be a determination on the part of farmers to still foster the improvement now being made in the grades of swine raised for the market.

The protracted drought of last year materially interfered with the last wheat crop. It militated not only against the growth of wheat, but prevented many growers from putting in the usual number of acres, and put off the seeding time till late in the fall. Various estimates have been made of the effect the drought had upon the crop. Perhaps not more than half the usual crop was harvested. In the spring, many fields sown to wheat in the fall were plowed up and planted to spring crops, and many that were more promising were so poor as not to be worth harvesting. Of course all fields did not suffer alike; some farmers report larger yields than for any previous year,—but from the best information to be had on the subject, a fair average of the yield would appear to be about ten bushels per acre.

But very little barley and no rye is grown in this county.

The yield of corn this year is far above the average. The season proved to be very favorable for it. The lowest average yield reported was forty bushels of shelled corn per acre.

A very generous yield of oats is reported from all sections of the county. No doubt it is above the average crop,—the supply at least appears to be greater than usual.

Fruit and vegetables have also bountifully yielded. Especially is this true with regard to apples. The supply has been much beyond the demand. The quality of apples, as well as the supply, has been better than ordinary. At the fair the show of apples was exceedingly fine, and evidenced a very great improvement in the orchards of the county.

Potatoes yielded very meagerly. That persistent and hardy bug, the Colorado Beetle, infested every field, and its ravages certainly equaled that of any other year. Even where Paris-green was freely used, and much time spent in destroying the bug in other manners, the vines were seriously affected. Besides the great influence of the bug against a fair yield, the season was not as favorable as could have been wished. One thing and another reduced the crop to about thirty bushels to the acre.

This county is comparatively new; but rapid strides are being made in improvements. The most generally approved implements are used, and good buildings are being erected in every township. Generally the best modes are adopted in cultivating the land, and improved methods and seeds are sought and tried. A general system of drainage has greatly benefited the lands as well as the health of the people, and the time is not distant when Shiawassee county will rank, as a farming district, with the best in the State.

C. Y. OSBURN, *Secretary.*

TUSCOLA COUNTY.

The past season has been a diversified one; not wholly unfavorable, however, to the farming interest. The autumn of 1871 was unusually dry; winter closed in without any considerable amount of rain. There was little snow during the winter; the spring was moderately wet; the summer was quite dry, less so however than the previous one; the late fall was also dry. These are some of the more prominent climatic peculiarities of the past year.

In regard to wheat it must be admitted that the crop was nearly a failure in the northern part of the county, but our neighbors in the more southern towns were more fortunate, securing a fair crop. We judge the average to be about fifteen bushels per acre. Generally the crop was inferior in quality.

The corn crop was a very good one, averaging about forty bushels of shelled corn to the acre. Cutworms were very numerous and destructive; that portion of the crop that survived their depredations matured well, giving a very fair return. Nothing is more noticeable than the effect of good culture in the management of corn while growing, giving as it does an earlier and heavier growth, and also a better quality of grain.

The oat crop was a good one, yielding about forty bushels to the acre; it was generally secured in good order.

Beans, buckwheat, barley, and rye, are cultivated to a limited extent only. Our soils are no doubt well adapted to their growth, but the culture of wheat, corn, oats, and grass, is doubtless more profitable to the farmer; at any rate these crops seem to take precedence in the estimation of our grain growers.

We consider the hay crop an average one in quantity, and also in quality. Some are quite decidedly of the opinion that raising hay and keeping cattle, horses, and sheep are even now more profitable than raising grain exclusively; and when we consider the exhausting effect of constant cropping upon the soil, the idea cannot be deemed a very irrational one. We place the average at about one ton and a half to the acre.

The potato-bug damaged the potato crop to a considerable extent; fewer were planted on this account. It is thought by some that they were less troublesome than during the previous year, yet potatoes are scarce where the bugs were left to breed and feed upon the vines unmolested. One hundred bushels is the estimated average per acre.

Fruit of all kinds was abundant, except peaches; this fruit, usually abundant in favorable localities, failed almost entirely this year. The wormy condition of the apple crop, and the destruction of plums by the curculio, warn us that to succeed in the culture of fruit no pains should be spared in arresting the increase of those noxious insects, that, by their depredations, so materially damage the fruit business in all parts of the country. We suggest that in purchasing trees, vines, etc., for our orchards and gardens, home institutions be patronized where practicable, and in no case to buy of nursery men who have not by fair and honorable dealing in the past, acquired a favorable reputation.

Our remarks in regard to horses, cattle, and sheep, in former reports, would not be out of place here. A very praiseworthy effort is still being made in the way of improving breeds, the effects of which are manifest in the appearance of stock generally throughout the county.

Pork-raising has not given satisfactory returns the past year. No particular interest seems to be manifested in the business at present. A commodity, however, in so universal demand, cannot remain long unprofitable, and farmers should not relax their efforts to improve the blood,—early development, ease of fattening, quietness of disposition, etc. being considered desirable points.

Our manufacturing establishments remain prosperous, and are doing very much in the way of furnishing articles necessary for our use in the every-day affairs of life. There is doubtless ample room for more, which will be occupied as our requirements become known among parties with the necessary means, looking for suitable opportunities for investing capital in the manufacturing business.

The last annual meeting was held at Watrousville, on the eighth day of January, 1872. The President, Mr. Nuth, being absent, Mr. J. D. Hays, Vice President, from Gilford, was called to the chair. At said meeting the following persons were elected to office in the Society:

President—C. R. Selden of Denmark.

C. C. Stoddard and R. C. Burtis were re-elected Secretary and Treasurer, respectively.

Executive Committee—Gearhart Kile of Juniata; N. E. York of Arbella; H. C. Marvin of Columbia; Dr. Wm. Johnson of Vassar, and J. R. Hooper of Indian Fields.

Auditors—E. B. Hays of Juniata, and M. D. Nuth of Vassar. Also a Vice President in each township in the county.

The fair was held on the 25th, 26th, and 27th days of September. The weather was too cool and windy to be comfortable out of doors, still the attendance was good, while the exhibition was, in point of attractions, nearly or quite equal to any fair previously held by the Society. The show in vegetables was unusually good. The absence of peaches was noticeable, and detracted somewhat from the merits of the fair.

In conclusion, we express our continued interest in the success of the Society; and we earnestly wish that the people of the county would take the interest in the success of the Society which it seems to us their interests demand that they should do.

C. C. STODDARD, *Secretary.*

VAN BUREN COUNTY.

O. H. P. Sheldon, Secretary, writes:

Our society is in a flourishing condition. The exhibition for 1872 compared favorably with those of former years. The number of entries was less, but the quality of the articles shown was much superior to that of previous years.

The receipts amounted to $1,629.33; expenditures, $1,486.23

There was a fine exhibition of cattle, and nearly all were of the improved breeds.

Horses are rapidly increasing in numbers in the county, and the quality probably keeps pace with the increase. All classes were well represented, and the number of entries of young horses and colts was so great that the judges found great difficulty in making impartial awards.

The interest in sheep seems not so great as in former years, still there were on exhibition some fine specimens of Merinoes and a few long-wooled sheep.

Notwithstanding the low price of pork, the interest in swine is very lively, and no trouble or expense is spared to procure the very best breeds.

The officers for the ensuing year are: F. M. Manning, President; David Woodman, Vice President; Joseph Kilburn, Treasurer; O. H. P. Sheldon, Secretary.

The spring opened very late, the summer was very hot, and after the first of June exceedingly dry.

The wheat crop was considerably more than an average in quantity, and the quality was excellent; on some pieces the yield was over forty bushels to the acre.

Corn was hardly an average crop, owing to the dry weather, but the quality was fair.

The extremely dry and hot weather made the oat crop very light. Buckwheat and hay were similarly affected.

Potatoes were much injured by the *potato-bug,* some pieces nearly ruined.

Apples were not as abundant as last year, and the quality was poor; they began falling early and were much affected by worms.

Peaches gave a fair crop, but many of them were stung.

WHIPPLETREES AND DRAUGHT.

BY M. MILES.

From the earliest times of which we have any record, the superior strength of animals has been made use of by man in work.

The ox and the ass were first used as beasts of burden and afterwards for purposes of draught. The horse, from its greater intelligence and tractability, was for a long time exempt from the ordinary labor required of the animals mentioned, and kept for the personal use of its master in war or in moving from place to place.

The Anglo Saxons prohibited the use of the horse in field labor, the ox being exclusively used for that purpose.

On a piece of "tapestry, woven at Bayonne in the time of William the Conqueror (A. D. 1066), there is the figure of a man driving a horse attached to a harrow. This is the earliest notice we have of the use of the horse in field labor."

A history of the means employed from time to time in harnessing animals to the load to be moved would be of considerable interest; but we unfortunately lack the materials required in its compilation.

The first methods of attachment were undoubtedly rude and imperfect; the only consideration being to accomplish the end in the simplest manner, regardless of the comfort of the animals.

"It was a law of the early Britons that no one should guide a plow until he could make one, and that the driver should make the traces by which it was drawn of withs or twisted willows."

In many places withs were used for attaching the tails of animals to the plow or harrow. "In 1610, Mr. Ledwich says, ten shillings were levied for every plow drawn by the tail in Ulster, There were 1,740 forfeitures, amounting to £870." (Dutton's Survey of Galway, p. 83.)

A law of the Irish Parliament (11 and 12 Car. 11, c. 15), in 1634 entitled "An act against plowing by the tayle, etc.," declared that "in many places of this Kingdome there hath been a long time used a barbarous custome of plowing, harrowing, drawing, and working with horses, mares, geldings, garrans, and colts by the taile, whereby (besides the cruelty used to the beasts) the breed of horses is much impaired in this Kingdome."

"These wretched practices are then declared illegal and to be punishable by fine and imprisonment."

This law with its penalties did not, however, prevent the evil.

Mr. C. Varley, a resident of Ireland, in his New System of Husbandry, 1774, says: "I have very often seen a mare and her offspring—a three-year old, two-year old, and one-year old colt,—plowing all abreast, two going upon the ploughed land and two upon the unploughed land, with neither hemp nor iron about them; their whole gearing consisted of a withy or twisted stick tied to the hair of the horse's tail and so through a hole made in a long pole or stick which reached the breadth of the four horses and served by the way of a swingletree, which pole is fastened in the middle by another withy to a hole bored in the end of the plough beam."

Arthur Young in his Tour of Ireland, 1776, when in Ulster, says: "They plough all with horses three or four in a plough and all abreast. Here let it be remarked that they *very commonly plough* and *with their horses* DRAWING BY THE TAIL,—it is done every season. Nothing can put them beside this, and they insist, that take a horse tired in traces and put him to work by the tail, he will draw better,—quite fresh again. Indignant reader! this is no jest of mine, but cruel, stubborn, barbarous truth. It is so all over Cavan."

In speaking of another locality in Ireland, the same writer says: "They harrow by the tail,—item, the fellow who leads the horses of a plow walks backward before them the whole day long, and in order to make them advance strikes them in the face."

McDonald, in his Survey of the Hebrides in 1808, says the common practice was to fasten horses and colts by the tail to the harrow. "In Wales the man who led the horses or oxen (of which from four to six were used), walked backward. The cattle were fastened with withs to a long whippletree, three abreast, the outside ones walking respectively on the ploughed and unploughed land, while the center ones walked in the furrow."

The common use of withs in harnessing the team gave rise to names that were used after the withs were replaced by better materials,—and it is not improbable that terms now in use were derived from them.

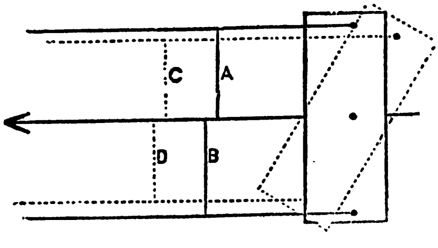
The womb-withy (belly-with) became wamb-tye or wantye, and the *withentrees*, witten-trees, and swingle-trees were what we now call whiffletrees and whippletrees, or in an abreviated form, doubletrees and singletrees.

The double whippletree, as now used, is intended to equalize the work performed by horses working in pairs. In construction, its true purpose of equalizing the draught is often lost sight of in the attempts to secure the greatest strength of timber to meet the resistance.

To secure an equal division of the work performed, in all positions of the doubletree, the draught pins must be in the same line.

Diagram No. 1 shows the working of a doubletree properly constructed, with the main draught pin in line with the whippletree pins.

No. 1.



When the doubletree is at right angles to the line of draught (as shown on the diagram by the black lines), if lines are drawn from the whippletree pins parallel to the center line they will be equidistant from it, as shown by the equal length of the lines A and B.

When the double tree is not at right angles to the line of draught (as shown on the diagram by the dotted lines), if lines are drawn in the same manner from the whippletree pins they will be nearer the center line, but still equidistant from it, as shown by the equal length of the lines C and D.

In both cases the work performed by each horse will be the same.

With a doubletree thus made it will be readily seen that it makes no difference whether one horse is ahead of the other or not.

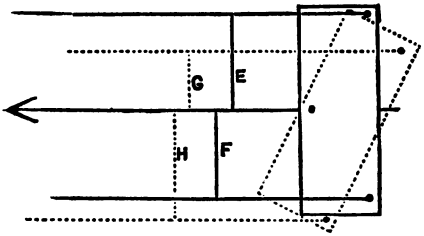
In a very common form of the doubletree we find the main draught pin is placed near the front edge, and the whippletree pins are placed near the rear edge, thus securing the greatest strength of the timber.

An examination of a large number of doubletrees in different parts of the country shows this to be a form quite generally adopted; the prominent idea in construction being, apparently, to obtain the greatest strength with the smallest amount of material. When so made, if the doubletree is at right angles to the line of draught, the force exerted by each animal will be the same, but in all other positions it will be unequal.

It will, perhaps, be generally admitted that with ordinary teams, in the hands of careless or unexperienced drivers, the doubletree will seldom be at right angles to the line of draught, —the position required for equalizing the draught.

The effect of placing the main draught pin in *front* of a line drawn between the two whippletree pins is shown in diagram No. 2.

No. 2.



Here, as in the preceding diagram, when the doubletree is at right angles to the line of draught, as indicated by the black lines, the work done by each horse will be the same,—the lines E and F being equal.

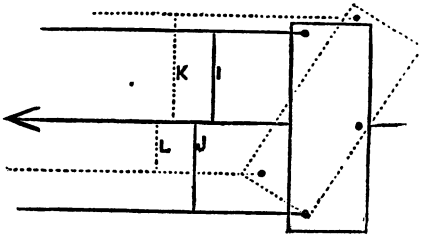
When not at right angles to the line of draught the horse that is *ahead* does *less* than one-half of the work, the line H (representing the length of the forward end of the doubletree) being longer than the line G (representing the length of the rear end).

A spirited horse, working with a mate of a less ardent disposition, will often keep *ahead*, and thus be relieved from the performance of its share of the burden.

Another serious objection to this form of doubletree is that as its position is changed the work performed by each animal varies, and this, in heavy draught, with animals of high temper, becomes annoying and often leads to fickleness.

The effect of placing the main draught pin *behind* the line connecting the whippletree pins is shown in diagram No. 3.

No. 3.



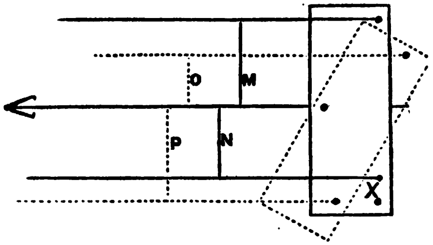
As before, an examination of the black lines shows that each horse performs the same amount of work when the doubletree is at right angles to the line of draught—the lines I and J being equal.

In any other position the horse that is *ahead* does more than one-half of the work, the line drawn from the forward whippletree pin being nearer the center line than that drawn from the rear whippletree pin,—the work performed by each horse being inversely as the length of the lines K and L. In other words, the work performed by the forward horse would be represented by the length of the line K, and the work performed by the horse falling behind would be represented by the length of the line L.

Sometimes it is desirable to give a horse the "*advantage,*" as it is termed, by placing the whippletree pin of its mate nearer the main draught pin.

Let us examine the effects of this arrangement, as shown in Diagram No. 4, with a doubletree constructed as in Diagram No. 2.

No. 4.



As the lines M and N in this figure represent the distances, respectively, of the whippletree pins from the center line,—with the doubletree in the position indicated by the black lines,—the horse working on the long arm M would do less than one-half of the work, as intended.

If the "*short end*" of the doubletree (marked X) moves forward, the proportion of work done by the horse drawing from X is constantly diminishing, until in the position indicated by the dotted lines, he is doing less than one-half of the work,—

the line P being longer than the line O,—the reverse of what was intended.

In a position of the doubletree between those indicated on the diagram, the work performed by each horse would be the same.

If the "*long end*" of the doubletree is moved forward,—the opposite effect will be produced,—the "*advantage*" given the horse in the first position being increased, and he is thus doing less than his intended share of the work.

The desired "advantage" can only be obtained when the doubletree is in the first position.

If the doubletree is of the form represented in Diagram No. 3,—the main draught-pin being behind the line of the whippletree pins,—the reverse effect would be produced,—the horse having the "*advantage*" would loose it if it worked ahead of its mate, or it would gain a greater advantage by falling behind.

In the doubletree represented in Diagram No. 1,—with the main draught-pin in line with the whippletree pins,—any "*advantage*" given in one position would remain the same in proportion in any other position.

It will be noticed that the doubletrees represented in the diagrams are wider in proportion than those found in actual practice.

This variation from ordinary proportions was made on account of the small scale of the drawings, for the purpose of magnifying the effects of changes of position so that they could be readily detected by the eye.

Illustrations of the principle under discussion will now be taken from cases in practice, with the results obtained from actual measurement.

In quite a number of instances I have measured the doubletrees of omnibuses used for transporting passengers in towns. The length was found to be 4 feet, and the main draught pin was at least 4 inches behind the line of the whippletree pins,—a ratio of width to length of 1 to 12.

Farm doubletrees for sale at the implement stores were found 40 inches long with the main draught pin 3¼ inches in front of the line,—a ratio of 1 to 12.3.

The doubletrees on several of the leading mowing machines in market were measured with the following result:

For obvious reasons the names of the machines are not given.

No. 1. Length of doubletree 32 inches,—main draught pin 2¼ inches out of line,—a ratio of 1 to 14.2.

No. 2. Doubletree 34 inches long,—main draught pin 3 inches out of line,—a ratio of 1 to 11.3.

No. 3. Doubletree 34 inches long,—main draught pin 4½ inches out of line,—a ratio of 1 to 7.5.

No. 4. Doubletree 29 inches long,—main draught pin 5 inches out of line,—a ratio of 1 to 5.8.

In all cases the distance from center to center of the whippletree pins has been given as the length.

As these mowers are sold by thousands throughout the country, the effect of these peculiarities of the doubletrees on the draught, becomes a matter of great practical importance.

Taking the results of the New York trials of mowers and reapers for a standard, it will be fair to estimate the draught of mower No. 4 at 200 lbs. in ordinary work.

As the main draught pin is behind the line of the whippletree pins in this doubletree the effect of changes of position will be as shown in diagram No. 3.

With the proportions given above,—a ratio of 1 to 5.8,—if one end of the doubletree is carried forward 4 inches,—a variation that is not unusual,—the horse that is ahead will be working on the arm of a lever 12.7 inches long, and the horse that is behind will be working on the arm of a lever 15.3 inches long. The "*advantage*" of the rear horse would therefore be 2.6 inches in leverage.

If the total draught is 200 lbs the forward horse would be drawing 109.3 lbs, and its mate only 90.7 lbs, a difference of nearly 19 lbs, or almost ten per cent of the load.

In this connection it becomes an important question as to the amount of work an ordinary horse is capable of performing each day for a considerable length of time.

Mr. Watt makes a conventional assumption that the power of a horse is represented by 33,000 pounds raised one foot in one minute, and this is generally adopted as the value of a horse-power in steam engines. This would be equivalent to moving 150 pounds at the rate of 2½ miles an hour for 8 hours each day.

This is, however, considerably above the estimate of many of the best engineers.

"Smeaton gives 100 lbs, moved at the same rate, and Hatchette 128 lbs. Numerous careful experiments on an English railway (detailed in "Laws of Excavation and Embankments on Railways," p. 105) gives 110 pounds moved 19.2 miles per day at the rate of 2.4 miles per hour. Gayffier fixes the power of a strong draught horse at 143 pounds for 22 miles per day at 2¾ miles per hour, and for the ordinary horse at 121 pounds for 25 miles per day at 2½ miles per hour. As the speed of a horse increases his power of draught diminishes very rapidly, till at last he can only move his own weight." (Gillespie on Roads, p. 67.)

The following table, copied from the same work, "shows the results obtained by different authors, those of Tredgold being for 6 hours daily labor, and those of Wood for 10 hours:

VELOCITY.	FORCE OF DRAUGHT, ACCORDING TO		
Miles per Hour.	Leslie.	Tredgold.	Wood.
2	100 lbs.	166 lbs.	125 lbs.
3	81 "	125 "	83 "
4	64 "	83 "	62 "
5	49 "	42 "	50 "
6	36 "	....	42 "
7	25 "	....	36 "
8	16 "	....	31 "

"From the above table it appears that according to Wood, at 4 miles per hour a horse can draw only half his load at 2 miles,—at 8 miles only a quarter. "At 10 miles per hour Tredgold considers the power of a horse to be 37 lbs. moved 10 miles per day,—at the same velocity Sir John Macneill estimates it at 60 lbs. moved 8 miles per day.

Mr. Youatt, in his valuable treatise "On Draught," says: "As regards the degree of resistance, when velocity is not required, a force of traction of from 100 lbs. to 125 lbs., or even 150 lbs., according to the strength of the horse, continued for eight hours a day at about two and a half to three miles per hour, is the best proportion of quantity and duration of labor,—that where six or eight miles per hour is required the duration of the day's work should be shortened to 5 or 6 hours and the draught reduced to 80 lbs. or 100 lbs. At still higher velocities the draught must not exceed 50 lbs. or 60 lbs. and the time of working two or three hours. But this speed can only be attained by the sacrifice of the horse,—and consequently the question will rather be what the horse is capable of doing, than what can be done with economy."

From these estimates of the working power of a horse it will be readily seen that the 19 pounds difference in the work performed by two horses working on a mower is a matter of great importance.

Let us analyze the proportions of the farm whippletrees mentioned with reference to the influence of a change of position upon the draught.

With a length of 40 inches and with the main draught pin 3½ inches back of the line of the whippletree pins, if one end of the doubletree is 5 inches forward of the position it would have when at right angles to the line of draught, the forward horse would be working on the arm of a lever 18.6 inches long, and the horse falling behind would be working on the arm of a lever 20.1 inches long,—a difference in leverage of 1.5 inches.

In plowing, with a total draught of 350 pounds (a fair average for two-horse plows, according to the New York trials), one horse would be exerting a force of 181.8 pounds, and the other would be exerting a force of 168.2 pounds,—a difference of 13.6 pounds.

Under the circumstances, this is really a greater difference than 20 pounds would be in the draught of the mower.

The total draught of the plow, divided between two horses, is 50 pounds greater for each than the estimated traction force a horse is capable of exerting for a considerable length of time.

In heavy draught, when a horse is working very nearly up to the extent of his powers, a slight increase in the required force is severely felt.

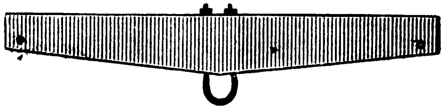
It is an old saying that "it is the last feather that breaks the camel's back." According to the calculation of sporting men "the addition of seven pounds weight in the rider makes the difference of a distance, which is 240 yards, in a four-mile race."

Any extra exertion required of a horse, in severe work, will *tell* in the long run.

Objectionable forms of doubletrees are often figured in works on agriculture, and some of them are endorsed by the best agricultural writers.

Three of the most "taking forms" will be particularly noticed, as they are types of classes that will be readily recognized.

No. 5.



This form of doubletree is frequently used in field work, the iron staple in the rear forming a convenient means of attaching to loads.

From the draft of a model 40 inches long, 4 inches wide in the middle, and 3 inches wide at the ends, with a staple in the rear of 1¾ inches in the clear, the following results have been obtained:

If one end of the doubletree is moved forward 4 inches, the horse working on that end would have a leverage of 18.9, and its mate would be working on the arm of a lever 20.4 inches long.

The horse falling behind would thus have an "advantage" of 1.5 inches in leverage.

If one of the whippletree pins is moved towards the main draught pin 1½ inches so as to give the horse working on the other end of the doubletree the "*advantage*" in work when the doubletree is at right angles to the line of draught, the effect of a change of position would be as follows:

When the long end of the doubletree is moved forward 4 inches the "advantage" would be lost, as each horse would then be working on the arm of a lever 18.9 inches long.

If the long arm is moved 4 inches back of its first position it would then be 20.4 inches long, and the short arm would be 17.4 inches,—a difference of 3 inches, or *twice* the "*advantage*" intended.

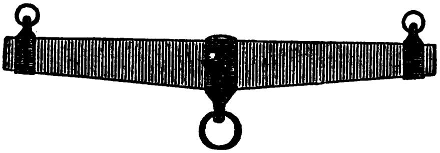
When the singletrees are attached to hooks on the front edge of the ends of a doubletree of this form, the defect is materially increased.

Retaining the proportions given above in other respects, the hooks for the singletrees would be at least 6 inches in front of the main draught pin,—a ratio of 1 to 6.7.

If one end is then moved 5 inches in front of the line at right angles to the line of draught, the short arm would be 18 inches and the long arm 20.75 inches,—or an "*advantage*" in leverage of 2¾ inches for the horse falling behind.

Doubletrees with iron bands around the middle and ends, as represented in cut No. 6, are often figured in agricultural books and papers as models of excellence, the strength thus obtained being alone considered.

No. 6.



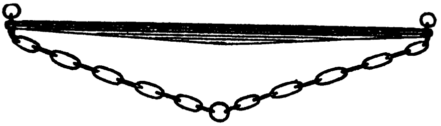
In heavy doubletrees the draught ring would be at least 5 inches behind the whippletree rings, which, with a length of 40 inches, would give a ratio of 1 to 8.

When one end of the doubletree is 5 inches in front of its position when at right angles to the line of draught, the forward horse would be working on the arm of a lever 18.25 inches long, and the hind horse would be working on the arm of a lever 20.6 inches long,—an advantage in leverage of 2.35 inches.

In plowing, with a total draught of 350 pounds, one horse would be exerting a force of 185.5 pounds and the other only 164.5 pounds,—a difference of 21 pounds.

Doubletrees are sometimes made with a small shaft of wood and iron chains fastened at each end, connected in the middle by a ring, as in cut No. 7.

No. 7.



The proportions of these doubletrees vary considerably, the center draught ring being often from 6 to 8 inches behind the whippletree rings.

These doubletrees are often used in heavy draught, when the whippletrees need to be frequently lifted in changing the direction of the line of draught.

From the illustrations already given it will be seen that the proportions of this form of doubletree will produce an inequality in the draught that will quite overbalance any other desirable qualities that it may possess.

The "truss whippletrees" that have been recommended on account of their "lightness and strength" are, on the same account, quite as objectionable as the forms figured above.

It will be seen from what has already been said, that the draught pins in the doubletree must be in the same line to secure an equal division of labor in all positions,—and that in any other form an "advantage" given to one horse is more imaginary than real.

It must be remembered in discussing this subject, that the effects of faulty construction in the doubletree are severely felt in heavy work where the power of the animals is fully exerted. Any additional force required under such circumstances cannot fail, in the long run, to result in permanent injury.

CLOSE BREEDING.

BY M. MILES.

A sharp and acrimonious discussion has, for a long time, been carried on between the advocates of close breeding and those who insist upon the exclusive practice of what is called out-crossing.

The arguments that have been urged with earnestness and zeal, on both sides, have failed to settle any points in the controversy.

The positive manner in which experience is appealed to by both parties, brings to mind the old fable of the discussion in regard to the color and bearings of a shield. Here, too, each party in the debate relied upon the evidence of their own senses; but the shield had two sides, only one of which had been seen by those who were engaged in the controversy.

The more modern story of the dispute about the color of the chameleon likewise furnishes a parallel case: several persons had seen it, yet they all differed as to its color; one said it was green, another said it was brown, while others said it was of some other color. Each knew that their own eyes had not deceived them, and that the others were mistaken. The important fact was, however, overlooked by them all that the color of the animal changed with the conditions in which it was placed.

In discussing the principles of breeding, the advocates of

NOTE.—The substance of this paper was given in a lecture before the American Association of Breeders of Short-Horns, at their meeting in Cincinnati, Dec. 8, 1878. In its present form it has been extended, and some of the points discussed are more fully illustrated.

each of the extreme views referred to, make their own definitions of terms used, and they are therefore proof against any arguments of their opponents.

On each side men of straw are set up, that are easily demolished when assailed from the standpoint of those who manufacture them.

As discussions based on partial views and unfounded assumptions, are of no practical interest, we do not propose to enter the lists as the champion of the extreme views of either party.

The terms in-and-in breeding, close-breeding, inter-breeding, and high-breeding are by some writers used as synonymous, while others make arbitrary distinctions in their meaning that are of no practical significance.

Some use these terms quite loosely,—applying them indifferently to any degrees of relationship, while others make use of them only to indicate the breeding together of the closest relations.

The following definitions of "in-and-in breeding" are selected from the few authors that have defined the term:

> The breeding from close affinities.—*Youatt.*—*Johnson.*
>
> Breeding between relations without reference to the degree of consanguinity.—*Randall.*
>
> Breeding from animals close of kin to each other.—*Copland.*
>
> It should only be applied to animals of precisely the same blood—as full brother and sister.—*Bowly.*
>
> Breeding from the same family, or putting animals of the nearest relationship together—*Sir John Sinclair.*
>
> The producing of a succession of animals from parents descended from the same original pair, with which the breeding series, so to speak, is commenced.—*R. S. Burn.*
>
> Breeding from a near relationship, such as a first cousin, or at the most (one) in the second or third degree.—*Stonehenge.*

Sir John Sebright, one of our best authorities on the subject of breeding, is often quoted as an opponent of "in-and-in' breeding.

In his work on "The Art of Improving the Breeds of Domestic Animals," he says in his remarks on in-and-in breeding

"Mr. Meynel's fox-hounds are likewise quoted as an instance of the success of this practice; but, upon speaking to that gentleman upon the subject, I found that he did not attach the meaning that I do to the term *in-and-in.* He said that he frequently bred from the father and the daughter, and the mother and son. That is not what I consider as breeding *in-and-in,*—for the daughter is only half of the same blood as the father, and will probably partake, in a great degree, of the properties of the mother."

Although Sir John Sinclair does not formally define the term as he understands it, it is fair to presume from this that he would limit it to closer relationships than those mentioned. It will be found, I think, that the apparently conflicting opinions of writers in regard to this subject have arisen, to a great extent, from the different meanings attached to these terms.

In this paper—without attempting to define critically the terms above mentioned, or to set a limit to the admissible relationships in breeding—it is my purpose to discuss the *principles* involved in breeding together animals that are closely related, as shown in the practice of those who are generally acknowledged to be the great masters of the art.

In order to prevent any misapprehension of the views here presented, it will be necessary, on the start, to call attention to some of the general principles of breeding.

The breeding of domestic animals is an *art,* the rules of which are founded almost exclusively upon experience and observation.

The principles underlying these rules can only be mastered by studying the practice of the most successful breeders.

The study of opinions, without reference to experience, will give rise to partial and extreme views, and these in turn will ead to errors in practice.

If we would gain a thorough knowledge of the rules of the art, and apply them successfully in practice, we must become familiar with what has been done by those who have made our improved breeds what they are.

The importance of improving the animals that man has subjected to his control, by domestication, has been urged from the earliest times, and the rule "breed from the best," has often been repeated as the only safe guide in practice. The truth of this rule was generally accepted by breeders, yet their practice showed that they failed to grasp its true meaning, and that its applications were often perverted.

Up to the time of Bakewell, the old routine practice prevailed, and but little progress was made in real improvement.

Bakewell introduced a new and artistic method, that marked the beginning of a new era in the history of breeding. His method, in fact, laid the foundation for the development of breeding as one of the *fine arts.*

He was the first to set up a definite standard of excellence, based on a thorough knowledge of the form and internal qualities best adapted to secure the highest development of the animal for a special purpose.

He was the first to form an *ideal conception* of the animal he wished to produce, and of the form and qualities best adapted to his purpose.

His standard of excellence was based on a careful study of the animal and of those qualities that had a real value, and he labored with an intelligent and persistent purpose to obtain it in his animals.

Unfortunately Mr. Bakewell did not leave any written record of the principles that governed his practice, and we only have some casual remarks reported by others, together with the animals that he produced, to furnish us a knowledge of his method.

One of his maxims was, that "like begets like," and this led him to the practice of close breeding.

He often said that "all was useless that was not beef," and he aimed to secure a tendency to fatten, in connection with early maturity.

The most successful breeders have recognized the fact that form alone is not sufficient to determine the characteristics of animals.

They observed, not only that their qualities were derived from their ancestors, but that all the characters of all the ancestors were likewise inherited.

It is true that some characters may be obscured and made latent, by the predominance of other characters; but the fact that these latent characters make their appearance under favorable circumstances shows that they have been inherited.

It is in the light of this principle that we must study pedigrees if we are to derive any practical benefit from them.

We should study pedigrees for the purpose of ascertaining the habits, characteristics, and tendencies of the ancestors of the animals we select for breeding.

In adhering strictly to the standard of excellence adopted in accordance with an ideal type, the breeders who have gained a world-wide reputation apparently found it necessary to limit their selection of breeding stock to animals descended from a common ancestry.

In other words, they selected only those animals that possessed in the highest degree the qualities they desired, and from the very circumstances of the case, on the principle already laid down, they were compelled to breed from animals that to a greater or less extent were related.

There were undoubtedly many who attempted to practice the method of Bakewell, but few however possessed the necessary skill and persistency of purpose to gain the highest success.

The truly great masters of the art of breeding can almost be counted on one's fingers, and their success can only be attributed to the possession of a combination of qualities that would ensure eminence in any profession or pursuit.

It is an old saying that "the poet is born, not made," and we may in the same sense truthfully say that the really great breeder is born, not made.

Let us for a moment consider some of the qualifications which the breeder should possess to enable him to attain the highest success.

He should have a thorough knowledge of the points of an animal that have the greatest value in adapting it to a particular purpose.

He should be unbiased in his judgment, and free from influence arising from considerations of ownership, or favorite theories.

As a reasoner he should be able to trace correctly the relations of cause and effect.

His eye should be trained to detect slight variations of form.

He must be patient and persevering in the course marked out, and adhere strictly to his standard of excellence without change of purpose. The time required to accomplish any great improvement in the qualities of animals, makes this a matter of the greatest importance.

Lastly the great breeder must be a true artist, capable of forming an ideal conception of what he would produce, and then moulding the plastic forms of his animals to give it expression.

Without these qualifications symmetrically blended the breeder cannot reasonably expect to become eminent in the practice of the art.

The art of breeding furnishes the opportunity for the full exercise of the highest faculties, and when rightly understood and thoroughly mastered it becomes one of the most interesting and fascinating pursuits.

In studying the practice of the great masters for the purpose of gaining a knowledge of the principles that were their guide, care must be taken that we do not mistake their real motives. Opinions formed in haste on insufficient data are apt to be erroneous, and the shadow is thus often mistaken for the substance.

A friend of mine, on his return from England, told me he had learned an important *secret* in breeding. It was this:

"breed from half-brother and sister." An examination of the pedigrees of the best-bred animals in the different improved breeds, would show that this advice was perhaps correct.

The best breeders had certainly bred from such relationships, and some of them quite often. It would not be safe, however, to adopt this as a rule, or to assume that it was accepted by the breeders referred to as a rule of practice.

A careful study of the principles that were the guide of these men would show that the selections were made to secure in both parents the same general characteristics, and that the close relationship pointed out, instead of being a real object, was only a necessary *incident* of their practice.

No matter what opinions we may form as to the advantages or disadvantages of close breeding, the fact remains the same: that all the great breeders have practiced it to a greater or less extent, and, as far as we are able to judge, with the same purpose,—that of retaining and fixing in their flocks and herds certain desirable characters.

The accompanying diagrams will better illustrate actual cases in practice than any labored description.

The pedigrees in several of these diagrams are arranged on a new plan. The name of each animal is given but once, and lines are drawn so that the relationships can be readily traced.

The pedigrees selected are from the Collings and Bates herds, not because they were more highly bred than others, but for the reason that attention has been more particularly called to them by the high prices realized at recent sales.

Quite as "*high*" breeding has been practiced, not only in other families of Short-horns, but in all breeds and in all varieties of animals.

In all of these the breeders evidently intended *to breed together animals of the same qualities, regardless of relationship.*

On diagram No. 2 the pedigree of Duke of Airdrie may be traced, beginning with the six animals at the extreme left of the diagram.

On diagram No. 1 the pedigrees of these same six animals arranged in a different order, may be traced back to Favorite by black lines, while the dotted lines if continued would run to Hubback.

Certain animals on diagram No. 2 are arranged in a different order, and taken for the basis of diagram No. 3, which gives the pedigrees of some of the "New York Mills" herd.

Diagram No. 4 gives the pedigree of a number of animals bred by Charles and Robert Colling.

In all of the diagrams the two lines coming together at the left of a name trace respectively to the sire and dam, while the lines from the right of the name run to the offspring.

The Booths practiced close breeding to a great extent as will be seen from an examination of the pedigrees of their animals. The pedigree of the sisters Queen of the May, Queen Mab, Queen of the Vale, and Queen of the Ocean; and their brother, Lord of the Valley (14837), bred by R. Booth of Warlaby, is given in diagram No. 6.

According to the calculations of Rev. J. Stone of Hellidon, "Crown Prince is 1055 times descended from Favorite, and Red Rose by Harbinger, 1344 times. So the produce of the two are descended from him 2399 times."—*Carr's History.*

Lord of the Valley and his sisters are 3-16 of the blood of Pilot, although he had not been used for five generations. They are also 5-16 of the blood of Buckingham.

Lord of the Isles (18267) is an illustration of still closer breeding; he was got by Sir Samuel out of Red Rose, by Harbinger. Sir Samuel was got by Crown Prince out of Charity, the dam of Crown Prince.

According to the same authority the *out-crosses* made use of by Mr. Booth, had a strong infusion of the blood of Favorite, Mussulman having 64 crosses, Lord Lieutenant 106 crosses, and Matchem 52 crosses of this favorite progenitor of the improved Short-horns.

In regard to other breeds attention is called to the following statements:

Mr. Price, the celebrated breeder of Herefords, says: "I bought from Mr. Tompkins a considerable number of his cows and heifers and two more bulls. I have kept the blood of these cattle unadulterated for forty years, and Mr. Tomkins assured me that he had bred the whole of his stock from two heifers and a bull, selected by himself early in life, without any cross of blood. My herd of cattle has, therefore, been bred '*in-and-in*,' as it is termed, for upwards of eighty years, and by far the greater part of it in a direct line, on both sides, from one cow now in calf for the twentieth time. I have bred three calves from her, by two of her sons, one of which is now the largest cow I have, possessing also the best form and constitution, the other two were bulls, and proved of great value,—thus showing indisputably that it is *not* requisite to mix the blood of the different kinds of the same race of animals, in order to keep them from degenerating."—*Farmers' Mag., 1841, vol. 14, p. 50.*

Mr. Quartly, the great improver of the Devons, bred his animals very closely.

The name of his bull, Prince of Wales (105), a celebrated prize-winner, is repeatedly found in the pedigrees of the best bred Devons of the present day.

His pedigree, which is as follows, shows that half-brother and sister were bred together twice in succession:

Quartly's Prince of Wales (105),	Prince Albert (102),	Hundred Guinea (56),	Sillifant (120).
			Curley (92).
		Splendid (415)	Sillifant (120).
			Dainty.
	Duchess (146),	Hundred Guinea (56).	
		Lilly.	

The highly bred cow, Eveleen V. (466), belonging to the Michigan State Agricultural College, is a regular breeder, and is remarkable for her feeding qualities and sound constitution.

Her dam traces to Forester 30 times, to Sillifant 10 times, to Hundred Guinea 7 times, and to Quartly's Prince of Wales 3 times, in 8 generations.

Her sire, within the same limits, traces to Forester 21 times, to Sillifant 20 times, to Hundred Guinea 13 times, and to Quartly's Prince of Wales 5 times.

Several of her sons, by Prince of Wales (317), who is quite as highly bred, are doing good service at the head of some of the best Devon herds at the West.

The Merino sheep, bred by the late Edwin Hammond, present a remarkable example of close breeding.

"They were bred in-and-in by Col. Humphreys up to the period of Mr. Atwood's purchase. Mr. Atwood bred his entire flock from *one ewe,* and never used any but pure Humphrey rams. Mr. Hammond has preserved the same blood entirely intact, and thus, after being drawn beyond all doubt from an unmixed Spanish Cabana, they have been bred in-and-in in the United States for upwards of sixty years."—*Randall's Practical Shepherd.*

The pedigree of the ram Gold Drop, for which Mr. Hammond refused $25,000, is given in diagram No. 5, in convenient form for study.

Dividing the "*blood*" of Gold Drop into 512 parts, it would be made up as follows:

	Parts.
Of Old Black	196
" first choice of old ewes	151
" " " " ewe lambs	109
" Dam of light colored ewe	28
" Old Matchless	28
Total	512

Old Greasy also represents 188 parts of blood in 512, and Wooster represents 138 parts in 512.

Sweepstakes is 9-16 of the "blood" of Old Greasy, and 13-32 of the "blood" of Wooster.

It will be seen that ten lines of descent may be traced from Old Greasy to Gold Drop, and fourteen lines of descent may be traced from Wooster to Gold Drop.

The Rich family of merino sheep furnish another example of successful close-breeding. Mr. Randall says they "were first crossed in 1842. They were then pre-eminently hardy. No one claims that they have gained either in hardiness or size by the cross; yet for thirty years preceding that period they had been bred strictly in-and-in, to say nothing of their previous in-and-in breeding in Spain."—*Practical Shepherd, p. 119.*

With sheep there has often been long continued interbreeding within the limits of the same flock. "The Messrs. Brown during fifty years have never infused fresh blood into their excellent flock of Leicesters. Since 1810 Mr. Barford has acted on the same principle with the Foscote flock. He asserts that half a century of experience has convinced him that when two nearly related animals are quite sound in constitution, in-and-in breeding does not induce degeneracy, but he adds that he "does not pride himself on breeding from the nearest affinities."—*Darwin's An. and Pl. under Domestication, Vol. II., p. 149.*

Numerous other examples of successful in-and-in breeding might be cited, but it will perhaps be unnecessary, as our purpose is simply to show that it has been quite generally practiced by those who have gained the reputation of having made improvements in the different breeds.

The practical question that we have to consider is: what are the *effects* of *close breeding?*

When this question is fully answered, we shall be prepared to form reasonable opinions in regard to the desirableness of close breeding in any particular case.

The first effect of close breeding to which attention is called is the fixing of the characters which animals already have.

If the principle already laid down is correct,—that the offspring cannot inherit any characters that the ancestors did not possess,—it would follow that the most prominent effect of close breeding is to fix in the offspring the characters of the ancestors.

If certain desirable characters predominate in the ancestors, so as to obscure and render latent certain other undesirable characters, these dominant characters should be more fully secured in the offspring by close breeding, and the latent characters should be less likely to make their appearance.

In this connection we must bear in mind the fact, that is too often overlooked, that in the highest development of our improved breeds of animals, the most desirable characters are highly artificial.

The conditions under which domesticated animals are placed differ widely from those which obtain in a state of nature, and their organization is necessarily modified by the artificial treatment which they receive.

It has frequently been noticed that when animals that have been domesticated are left to themselves, and allowed to return to their native condition,—to run wild, as it is termed,—that they lose after a time the peculiar characters that had been acquired when in a state of domestication.

For breeding purposes we make selection of the animals that present in the highest degree the artificial characters that adapt them to a special purpose.

In the beef-producing breeds, the largest proportion of choice meat, in connection with the desirable quality of early maturity, is most highly valued; while in the dairy breeds the production of milk is the most valuable quality, even when associated, as it usually is, with a slower growth and a lack of early maturity.

In the adaptation of an animal to a special purpose, the greater the departure from the natural condition the better.

We seek, in fact, the highest development of the artificial characters, and as a general rule we find that the widest variation from the original type, in a definite direction, is an indication of the greatest excellence.

In all efforts for improvement in the specialization of qualities, we should not, however, lose sight of the law of inheritance, to which attention has been directed.

It must be remembered that the qualities possessed by the ancestors can alone be inherited by the offspring.

How, then, are improvements to be made? and what are the causes of variation in the form and general qualities of animals?

All animals are endowed with a certain flexibility of organization, which enables them to adapt themselves to the conditions in which they are placed, each change of condition producing a corresponding change in their form and qualities.

Many illustrations of the effect of climate and food and habit in modifying animals might be given, but for our present purpose one example will answer.

The Kerry cattle, as found on their native hills in Ireland, are a small and hardy race.

The scanty supply of food that they obtained by industrious efforts, gave a slow growth and a late development of the organization, and it has been said that the heifers did not breed until 6 or 7 years old.

When removed to Massachusetts and placed under more favorable conditions for development the heifers breed at three years of age and they show a marked increase in size.

The better supply of food has given not only a larger growth but also an earlier maturity.

All of our improved beef-producing breeds have undoubtedly *gained* the desirable qualities of early maturity and a tendency to lay on fat by better care and a more abundant supply of food.

The improvements, however, that have been effected by these means during a series of generations, may be lost in a short time by placing the animals under less favorable conditions and materially diminishing the supply of food. A single illustration of the effects of such changed conditions will be given:

"During the French revolutionary war the excessive price of corn attracted the attention of the Glamorganshire farmers to the increased cultivation of it, and a great proportion of the best pastures were turned over by the plough,—cattle were almost entirely neglected. The natural consequence of inattention and starvation, was that the breed greatly degenerated in its disposition to fatten, and certainly, with many exceptions, but yet, as their general character, the Glamorganshire cattle became and are flat-sided, sharp in the hip-joints and shoulders, high in the rump, too long on the legs, with thick skins, and a delicate constitution."—*Youatt on Cattle, p. 51.*

After improving animals by modifications of food and habits, we can only fix and retain the artificial characters we have thus obtained, by breeding together the animals that possess them, and at the same time they must be kept under the same artificial conditions that gave rise to the desired variations in the first place. This fact, which is well known to experienced breeders, must not be lost sight of, as it is of the greatest importance in breeding improved animals.

We are too apt to adopt the erroneous notion that animals are *improved* by breeding. This idea has perhaps arisen from what is observed in the case of breeding a superior or high-bred male to an inferior female, when the offspring resembles the sire in a greater degree, and is almost invariably much better than the dam.

An improvement on the form and qualities of the one parent has been obtained, it is true, but the characters of the offspring have been inherited in a greater degree from the other parent. The best bred parent has had the greatest influence in determining the character of the offspring, and none but characters possessed by the ancestors have been inherited.

In connection with this subject of the improvement of animals, we must consider another influence, arising from what is known to naturalists as the law of the correllation of parts.

Dr. Carpenter says "it is perfectly true that, in a great majority of cases, the *extraordinary* development of one organ is *accompanied* by a corresponding deficiency of development in another. Thus, in the human cranium the elements which form the covering or protection of the brain are very largely developed, whilst those which constitute the face are comparatively small. In the long-snouted herbivorous mammals, as in reptiles and fishes, on the other hand, the great development of the bones of the face is coincident with a very small capacity of the cerebral cavity. In the Bat, whilst the anterior extremity is widely extended, so as to afford the animal the means of rising in the air, the posterior is very much lightened so as not to impede its flight. In the Kangaroo, on the other hand, the posterior members are very large and powerful, enabling the animal to take long leaps, while the fore-paws are proportionally small."—*Carp. Comp. Phys., p. 130.*

The celebrated naturalist, Milne Edwards, in his article on Crustacea, says, "It has long been admitted as an axiom in animal physics, that when any particular part of the body acquires a very high degree of development, certain other parts stop short of their ordinary state of evolution, as if the former had obtained their unusual increment at the cost of the latter." —*Cycl. Anat., Vol. I., p. 757.*

The well-known difficulty of combining in the highest excellence of the fat-producing and the milking qualities, is an illustration of the same principle.

Mr. Price, the breeder of Herefords already referred to, says: "Experience has taught me that no animals possessing form and other requisites giving them a great disposition *to fatten*, are calculated to give *much milk*; nor is it reasonable to suppose they should,—it would be in direct opposition to the law of nature. Had I *willed* it twenty years ago, my belief is that I could by this time have bred twenty cows purely from my own herd, which should have given a sufficient quantity of milk for (paying) dairy purposes; and I am equally confident that, in the same period, I could have bred a similar number that would not at any time, have given twenty quarts of milk per day among them. I feel confident I could effect either of these objects, much more easily and certainly than I could blend the two properties in the same animal, retaining also the form and quality best adapted to live hard and feed."—*Farmers' Magazine, XIV, p. 50.*

"Bakewell strongly insisted on the advantage of *small bones*, and the celebrated John Hunter declared that small bones were generally attended with corpulence, in all the various subjects he had an opportunity of examining."—*Sinclair's Code of Ag'l, p. 88.*

Mr. Henry Cline, an English surgeon, says: "The strength of an animal does not depend on the size of the bones, but on that of the muscles. Many animals with large bones are weak, their muscles being small. Animals that were imperfectly nourished during growth have their bones disproportionately large. If such deficiency of nourishment originated from a constitutional defect, which is the most frequent cause, they remain weak during life. *Large bones*, therefore, generally *indicate* an *imperfection* in the *organs of nutrition*."—*Observations on the Breeding and Form of Domestic Animals, p. 7.*

This principle of correlation, in fact, underlies the differences which exist in the several breeds of improved animals.

In each breed we find some prominent character that adapts it to a particular purpose, while other characters are obscured and made latent.

In breeding together animals with reference to the greatest development of any special character, a susceptibility to variation in the same direction, when placed under favorable conditions, is transmitted to the offspring.

By bringing into play the causes of variation already referred to,—an increased development in the special characters may thus be secured, until, by successive steps, the organization is, so to speak, out of balance.

In the breeds in which the fattening quality in connection with early maturity is the leading characteristic we seek to develop, their is danger of neglecting other qualities that are of great importance, which may result in serious injury to the constitution, and a loss of the powers of reproduction.

Mr. Darwin says: "Man selects and propagates modifications solely for his own use or fancy, and not for the creature's own good. His attention is struck by strongly marked modifications, which have appeared suddenly, due to some great disturbing cause in the organization. He attends almost exclusively to external characters, and when he succeeds in modifying internal organs, when, for instance, he reduces the bones and offal, or loads the viscera with fat, or gives early maturity, etc., the chances are strong that he will at the same time weaken the constitution."—*Animals under Domestication, II., p. 297.*

With an excessive development of the fattening quality, we may have loss of fecundity, a diminished secretion of milk, and delicacy of constitution.

From the lack of balance in the organization it will often be found more difficult to retain any desired character than to produce it.

From what has already been said, it will be seen that to produce any great development in a particular direction, without at the same time producing undesirable variations, will require the exercise of the greatest knowledge and skill.

As each breeder attempts to secure his own type of excellence, by shutting out all variations that are not in accordance with it, we have developed those peculiarities that are recognized as family characteristics.

From the manner in which these family characters are secured, it will be found exceedingly difficult to engraft any new character upon the family, without destroying to a greater or less extent the specific characters of the family.

This can only be effected by breeding within the family, from animals that fully represent the typical characters, to an extent that will prevent the engrafted character from becoming a dominant one.

A careful study of diagram No. 5 will show the skillful manner in which the blood of the Light Colored Ewe was infused into the flock of Mr. Hammond, to tone down the tendency to the production of excessive yolk, without destroying the other desirable qualities of the descendants of Old Black, and the 1st Choice of Old Ewes and 1st Choice of Ewe Lambs.

The next effect of close breeding we shall notice is *prepotency.*

This word is coming into common use among breeders, yet its true meaning is not always fully understood.

Potent means powerful and prepotent means very powerful, yet in this connection it has a more precise meaning. The word as commonly used is comparative, so that prepotency means greater power of transmission of characters.

When we say that an animal is prepotent, we mean that it possesses a greater power of transmitting its characters than the animal with which it is coupled.

It is long been observed by breeders that one parent often has a greater influence in determining the characters of the offspring than the other, and this term is a convenient one for indicating this influence.

Prepotency is a quality that breeders universally desire in their best animals.

As the male represents, in fact, one-half of the breeding herd, or flock, prepotency is one of the most highly valued qualities he can possess.

As we know of no other way of securing or producing prepotency but by close breeding, it has become a common practice among breeders to use a *high-bred* male. Even the opponents of *in-and-in* breeding gladly make use of the highest bred males they can procure.

It is the demand for high-bred males, in connection with a limited supply, that has produced the high prices that have been paid for the most fashionable pedigrees.

Those who owned the best females saw that they needed males more highly bred to give prepotency on the side of the sire, and a consequent increased uniformity of characters in the offspring.

From this it will be readily seen that close breeding should, perhaps, be limited to families for breeding sires, and this has, in fact, been the practice of nearly all the great breeders.

Mr. Hammond's "Queen Family," from which he bred his rams, was bred *in-and-in* to a greater extent than the rest of his flock. Jonas Webb kept five separate flocks, the rams used by himself being drawn from his favorite family.

The Duchess tribe was the source of the sires of Mr. Bates' herd, and Mr. Booth had his favorite families, from which the sires of his own herd are descended.

But there is another side to the shield which we must examine before deciding upon the advantages of close breeding.

We are told that in-and-in breeding causes barrenness and sterility, delicacy of constitution and effeminacy, and diminished size.

From a certain standpoint it must be admitted that there is too much truth in the claim that these defects are produced by close breeding.

If in-and-in breeding is practiced as a general rule, without regard to other considerations, these defects will undoubtedly be seen in the stock so bred.

Before condemning the practice of close breeding as inadmissible under any circumstances, or for any purpose, it will be well to examine all the facts bearing upon this side of the question, without prejudice, and with the purpose of ascertaining how far other causes may influence the alleged results.

If the principles already laid down are correct it must be admitted that in-and-in breeding, in itself considered, does not improve animals, and that it serves only as a means of fixing and retaining desirable variations that have been produced by other means.

It would not, perhaps, be unreasonable to assume that the converse of this proposition is also true—that in-and-in breeding does not in itself necessarily produce defects.

We will not, however, assert this without carefully examining the facts presented in the practice of the best breeders.

Mr. Darwin, whose peculiar theories are at this time attracting particular attention, has discussed this subject at considerable length, and cited many cases of interest that require consideration.

It is to be regretted, however, that many of the "facts" presented by Mr. Darwin,—on which he bases his generalizations,—need verification.

He says that close breeding *produces sterility*, but he adds, "It may, however, be carried to a greater extent with cattle and sheep, without injury, than in other animals."

He says further that "Bates' herd was estimated the most celebrated in the world. For thirteen years he bred most closely in-and-in, but during the next seventeen years, though he had the most exalted notions of the value of his own stock, he thrice infused fresh blood into his herd. It is said that he did this not to improve the form of his animals, but on account of their lessened fertility."

The crosses referred to, as is well known, were Belvedere, Matchem Cow, and Norfolk through Nonpareil by Magnet.

On diagram No. 1 the pedigrees of these three animals is shown by the side of that of 2d Hubback, Duchess 12th and Duchess 20th of Mr. Bates' original stock.

The black lines on the diagram trace to Favorite, and the dotted lines, if continued, would trace to Hubback.

It must be remembered in this connection that Mr. Bates said his rule in breeding was to "breed Hubback cows to the bull Favorite," and he likewise, after the purchase of the so-called out-crosses, made the claim that his short-horns were the only ones descended direct from Hubback to Favorite.

A close examination of the diagram will show that there is a marked similarity in this respect in the breeding of the three upper and the three lower animals:

Duchess	12th	has	32	crosses	of	Favorite	and	60	crosses	of Hubback.
"	20th	"	22	"	"	"	"	40	"	" "
2d Hubback		"	16	"	"	"	"	39	"	" "
Belvedere		"	18	"	"	"	"	60	"	" "
Matchem Cow		"	24	"	"	"	"	46	"	" "
Nonpareil		"	10	"	"	"	"	30	"	" "

These animals appear to be essentially of the same "blood," and close breeding has been carried to about the same extent in both groups.

The pedigrees apparently show the reasonableness of the statement made by Mr. Bates—that he introduced the last named animals into his herd because they were of the same blood of his own stock, and were bred in a similar manner.

Before attributing the loss of fecundity and delicacy of constitution, which are too often observed in breeding animals, to the influence of close breeding, it will be well to inquire whether there are any other causes of these defects, and if so, whether they are sufficient in themselves to produce them.

It will, perhaps, be generally admitted that a loss of the powers of reproduction are oftener observed in those breeds in which the fattening qualities are most highly developed.

We hear but little complaint in regard to loss of fecundity in the dairy breeds, or in sheep that are bred exclusively for the production of wool.

From this we might infer that the excessive development of the fattening qualities, interfered to some extent with the function of reproduction.

It is a popular notion that excessively fat animals or those that fatten easily, are not likely to breed well.

The remark is often made of a heifer of precocious development, even in herds not highly bred, "Yes, she is a beauty if she will only breed." The general prevalence of such expressions would seem to indicate that experience had shown that the excessive production of fat was incompatible with a high development of the reproductive powers.

It is on this ground that objections are made to what is called "*show condition*" in breeding stock.

Dr. Craigie remarks, "in females and eunuchs, it (fat) is more abundant than in males—in females deprived of the ovaries, it is more abundant than in those possessed of these organs, and it is well-known that sterility is frequent among the corpulent of both sexes. In some circumstances this accumulation may be so great as to constitute disease."—*Cycl. Anat. and Phys., Vol. I., p. 62.*

Sometimes we find the integrity of important organs impaired by depositions of fat or by the actual transformation of their substance into fatty tissue, which is known to medical men as "fatty degeneration."

Dr. Carpenter says: "There is one remarkable form of degeneration, however, which is common to nearly all tissues, and which seems to occur as a normal alteration in many of them at an advanced period of life; this consists in the conversion of their albuminous or gelatinous materials into fat, thus constituting what is known as fatty degeneration. That this change is not due to the removal of the normal components of the tissues, and the substitution of newly deposited fatty matter in their place, but is (in most cases at least) the result of a real conversion of the one class of substance into the other, has been already pointed out."—*Human Phys., p. 553.*

"There is reason to believe that 'fatty degeneration,' the form under which degeneration most commonly presents itself, is in reality far more frequent than simple wasting of the tissues, but it attracts less notice because their bulk is little or not at all diminished, and it is only when their function becomes impaired that attention is seriously drawn to the change."—*Hum. Phys., p. 559.*

Dr. Flint, one of our best authorities on the subject of physiology, says fat "does not take part in the nutrition of the parts that are endowed, to an eminent degree, with the so-called vital functions; and when these tissues are brought to their highest point of functional development, the fat is entirely removed from their substance. Long disuse of any part will produce such changes in its power of appropriating nitrogenized material for its regeneration that it soon becomes atrophied and altered. Instead of the normal nitrogenized elements of the tissue, we have under these circumstances a deposition of fatty matter. The fat is here inert, and takes the place of the substance that gives to the part its characteristic function. These phenomena are strikingly apparent in muscles that have been long disused or paralyzed, or in nerves that have lost their functional activity. If the change be not too extensive the fat may be made to disappear, and the part will return to its normal constitution by appropriate exercise; but frequently the alteration has proceeded so far as to be irremediably and permanent."—*Flint's Phys. of Nutrition, pp. 381, 382.*

These physiological considerations would give plausibility to the opinion that these fatty degenerations might involve those organs concerned in reproduction, but the question can of course be settled only by actual observation. Prof. Tanner says, in his paper on the reproductive powers of domesticated animals, that "the non-impregnation of the female may generally be traced to an excessive fatness in one or both of the animals, and an absence of constitutional vigor. The breeding powers are most energetic when the animals are in moderate condition, uninfluenced either by extreme fatness or leanness."

"For the purpose of more fully investigating the causes of barrenness, I have examined the ovaries of several heifers which were, after a very careful trial, condemned and killed as barreners, and I have every reason to believe that by far the larger proportion, were naturally quite competent for breeding, and that in the majority of cases non-impregnation arose from the seminal fluid never reaching the ovum, which was ready for fertilization, or from that fluid not being of a healthy character. In some cases in which the ova were to all appearances perfectly healthy, the tubes—whereby the seminal fluid should have been conveyed—were so overcharged with fatty matter that impregnation was rendered impossible. In other cases the ovaries were in an unhealthy condition, either one or both having to a great extent wasted away. Sometimes one of the ovaries had been suffering from atrophy, and the other in such an irritable and sensitive condition that it might be almost described as inflamed, and under such circumstances the formation of a healthy ovum could be scarcely expected. In other instances the ovaries had become considerably enlarged, in consequence of a *fatty degeneration* of these organs having taken place."—*Jour. Roy. Ag. Soc., 1865, pp. 265, 266.*

It is to be regretted that the condition of these animals, in regard to fattening tendency and constitutional peculiarities, had not been fully reported by Prof. Tanner in connection with the above statement.

I have examined the ovaries of several barren heifers that were remarkable for their fattening qualities and early maturity, and found in all of them "*fatty degeneration*" of one or both ovaries in a marked degree.

When the "*fatty degeneration*" was confined to but one ovary the other was in an irritable and unhealthy condition so as to prevent the development of a healthy ovum.

Attention should also be given to the principle of correlation in a full examination of the subject of sterility and barrenness.

An excessive development of the fat-producing function, which, it must be remembered, is an artificial character in marked contrast to the natural condition, may be accompanied by a lack of development or functional activity of some other part of the organization, as for instance in the glands secreting milk, or in the organs of reproduction.

The difficulty of combining the highest excellence in the production of fat and the secretion of milk is a matter of common observation.

The opinion of Mr. Price in regard to this has already been quoted, and his statement will, without doubt, be endorsed by a large proportion of breeders of experience.

It is logical to attribute a dimunition in the secretion of milk to a predominating tendency to produce fat, and at the same time attribute the defective performance of the allied function of reproduction to close breeding.

With a diminished secretion of milk a loss of fecundity is often associated, and both functions are undoubtedly influenced alike by the same causes.

"The formation of milk, says Prof. Tanner, is intimately connected with the reproductive powers. The secretion of milk is dependent upon the action of the activity of the mammary glands, and these are either under the direct influence of the breeding organs, or else they sympathize very closely with them. Those animals which breed with the least difficulty yield the best supplies of milk, and produce the most healthy and vigorous offspring. Now, it must be admitted, that however much we have improved the symmetry and feeding-power of stock, we have suffered them to deteriorate in value as breeding animals by the decrease of their milking capabilities. In proportion as we adopt a more natural system of management for the purpose of keeping stock in a healthy and vigorous breeding condition, so shall we reap the indirect benefit of a better supply of milk. It is true that a deficiency in the yield of milk may be met by other resources, but since a short supply of milk is indicative of, and associated with, enfeebled breeding powers, every care should be taken to obviate this defect."—*Jour. Roy. Ag. Soc., 1865, p. 270.*

There are other causes of barrenness, that require consideration.

Changed conditions of life are often referred to by authors as a common cause of barrenness.

Prof. Tanner in the paper already referred to, says "the general system of diet must also be looked upon as taking its share in influencing the reproductive functions. When the fall of rain has been small, and the herbage more than usually parched, we find unusual difficulty in getting ordinary farm stock to breed—a dry dietary is very unfavorable for breeding animals, and very much retards successful impregnation. On the other hand, rich, juicy, and succulent vegetation is very generally favorable to breeding. Apart, therefore, from the direct influence of the food given, it is certain that the condition in which it is consumed materially influences the breeding powers."—*Jour. Roy. Ag. Soc., 1865, p. 269.*

Mr. Darwin cites a large number of cases in which changed conditions have produced sterility,—a few of which will be quoted:

"I will now attempt to show that animals and plants when removed from their natural conditions, are often rendered in some degree infertile or completely barren, and this occurs even when the conditions have not been greatly changed."

"The Carnivora in the Zoological Gardens were formerly less freely exposed to the air and cold than at present, and this change of treatment, as I was assured by the former superintendent, Mr. Miller, greatly increased their fertility."

"Ranlin asserts that in the hot valleys of the equatorial Cordillera sheep are not fully fecund, and according to Lord Somville the Merino sheep which he imported from Spain were not at first perfectly fertile."

"In Europe, close confinement has a marked effect on the fertility of the fowl. It has been found in France that with fowls allowed considerable freedom, only twenty per cent. of the eggs failed; when allowed less freedom, forty per cent.

failed, and in close confinement, sixty out of the hundred were not hatched."

The artificial conditions under which our improved breeds are kept have a decided influence on their reproductive powers, and to this cause alone many cases of barrenness may undoubtedly be traced.

The large number of instances in which closely bred animals have proved to be good breeders, show conclusively that loss of fertility is not necessarily produced by "high breeding."

On diagram No. 4 will be found the pedigrees of a group of animals remarkably in-bred.

If in-and-in breeding causes barrenness we should certainly look for it in animals thus bred.

Clarissa, bred by Robt. Colling, was calved in 1814, and produced calves in 1817, '18, and '19, as shown by the Herd Book.

Her daughter Restless, got by Lancaster (360), who was more than a half-brother to Clarissa, was breeding at 6 and 7 years of age.

Lancaster, the highest priced animal at R. Colling's sale in 1818 (621 guineas), proved a valuable sire, and his name is to be found in many of the best pedigrees of the present day.

The pedigrees of several other celebrated animals may also be traced on the diagram.

The pedigree of the bull Grazier (1085) is given in diagram No. 7.

Grazier was bred by Mr. Wiley, of Brandsby,—near York. He was used in the herds of Earl of Carlisle, Lord Feversham, Sir John Johnstone, Sir I. Ramsdon, Mr. Wm. Smith, and Mr. Slater. He died at Byram when 14 years of age.

Twenty seven-sixty fourths of his blood was that of Favorite —who appears for the first time in the pedigree at the third generation back.

Thirty-one descendants of the cow "Charmer" were sold in England on the 28th of March, 1860.

In the advertisement of the sale it was stated that they were "*capital milkers and very prolific, not having been pampered.*"

They sold for £2,140, or an average of $350 each, and many of them were calves.

In connection with this statement taken from Goodale's work "On Breeding," some extracts from the Agricultural Gazette, published a few days before the sale, are copied, from which the following is quoted: "It will be found on examination that in so far as 'Charmer's' pedigree is known, which it is in some instances to the sixteenth generation, she is not only one-sixteenth only, but nearly nine-sixteenths of pure Favorite blood. This arises from Favorite having been used repeatedly on cows descended from himself. In the pedigree of 'Charmer' we repeatedly meet with 'Comet,'—'Comet' was by 'Favorite,' and his dam, 'Young Phœnix,' was also by 'Favorite;'—with 'George,'—'George' was by 'Favorite,' and his dam, 'Lady Grace,' was also by 'Favorite;'—with 'Chilton,'—'Chilton' was by 'Favorite,' and his dam also was by 'Favorite;'—with 'Minor,'—'Minor' was by 'Favorite' and his dam also was by 'Favorite';—with 'Peeress,'—she was by 'Favorite,' and her dam also was by 'Favorite;'—with 'Bright Eyes,'—she was by 'Favorite,' and her dam also by 'Favorite;'—with 'Strawberry,'—she was by 'Favorite,' and her dam by 'Favorite;' 'Dandy' and 'Moss Rose' among the cows, and 'North Star' among the bulls, are also of similar descent." Charmer traces 408 lines of descent to Favorite.

An examination of the pedigree will show that bulls descended from half-brothers and sisters were used eighteen times, as follows: Midas five, Barmpton six, Young Lancaster three, Sultan two, and Pope and Northampton once each.

Twenty-four times animals appear whose dam was daughter of their sire.

In this family we find a good illustration of the principle to which we have already called attention,—that "good milking" qualities and "good breeding" qualities are usually associated,—and this may safely be attributed to the animals "not having been pampered."

If this family had been reared under highly artificial conditions, accompanied by high feeding, so as to diminish the activity of the milking and reproductive powers, the instance would most certainly have been cited as an illustration of the evil effects of high breeding, and the real cause would have been overlooked.

All the cases cited under this head are from the Short-Horn breed.

The following examples of high-bred Herefords will be of interest in this connection.

In the first volume of the Hereford Herd Book is a portrait of the bull Cotmore (376). "He was the winner of the first prize in his class at the first meeting of the Royal Agricultural Society of England, held at Oxford. He was also a winner of many local prizes, and was, perhaps, one of the finest bulls ever seen; his colossal proportions were something very astounding, as may be inferred from the fact that the live weight was 35 cwt. He was bred by Mr. Jeffries, the Grove, near Leominster."

The pedigree of Cotmore, given in diagram No. 8, shows the closest in-and-in breeding.

"Sovereign (404), when at the age of *fifteen* years, was his sire, but he was not of the same enormous size, although acknowledged to be one of the best stock-getters of his day. He was bred by Mr. Fewer, and very closely in-and-in bred."—*Hereford Breed of Cattle, by T. Duckham, p. 18, in Vol. VI., of Hereford Herd Book.*

The pedigree shows that the sire of Cotmore (Sovereign) was the produce of (Favorite and Countess) full brother and sister, their sire and dam (Young Wellington and Cherry) were half-brother and sister, and that their grand-dams (Silky and Old Cherry) were half-sisters.

Lottery, the sire of Cotmore's dam, was not only closely bred, but we find him descended from the same animals as Sovereign.

The pedigree of Cotmore's grand-dam is not given in the Herd Book.

Sir John Sebright, in his valuable essay on "Improving the Breeds," has made the suggestion that it would be desirable to separate closely related animals, and subject them to different conditions of food and climate, so that their development might not be precisely the same. When selections of animals with a tendency to barrenness have been made, this would undoubtedly have an influence in restoring fertility.

Very often animals kept under precisely the same conditions fail to breed when coupled together, but when coupled with animals that have been subjected to different conditions they are found to be fertile.

In many cases in which closely related animals have failed to breed, they have proved fertile when coupled with animals of other herds, thus showing that the reproductive powers were not really wanting, but remained latent until their tendencies were properly supplemented.

It has been found that a defective performance of the function of reproduction may be corrected by suitable selections within the family without the infusion of other blood.

The manner in which this may be accomplished, will be seen, by applying the principle of correllation in development which has been briefly referred to.

Let us suppose the case of two animals closely related, with a high development of the fattening qualties, the one deficient in bone and the other with a tendency to a loss or perversion of the reproductive powers. When bred together, the defects supplementing each other, the balance of the system might be in a measure restored, so that the offspring inheriting the characters of both might be to a great extent free from the defects of either.

Duke of Airdrie (diagram No. 2) undoubtedly owes his superiority as a stock-getter to characters that he inherited in accordance with this principle.

His sire, Duke of Gloster, was not remarkably prolific, and there was a marked peculiarity in the character of his offspring, the bulls being very good, while the heifers were quite "plain," if not inferior.

The bulls of his get apparently derived their characters from their grandsire, Grand Duke, a very superior animal, while the heifers resembled their grandam.

Duke of Airdrie, who was got by Duke of Gloster out of Duchess of Athol, a superior animal and an excellent breeder, was a superior sire of both males and females.

The defects of Duke of Gloster as a breeder were apparently supplemented by Duchess of Athol, although they were closely related, so that the balance of organization was fully restored in their son.

Without reference to the principle of correllated development, cases like this are not easily explained.

On the same principle, a cross in color within the limits of the family has been recommended, and with apparent good reason.

As there is a practical difficulty in detecting all the peculiar tendencies of individuals so as to make selection, that would properly supplement each other, the general rule might be laid down, in breeding within the limits of a family, to match animals with reference to the essential, or more constant characters of the family, and mis-match them with reference to the varying or non-essential characters.

If this idea of supplementing qualities is accepted as of some possible value, the fashionable method of breeding only from animals of the desired color must be very objectionable.

If the views presented in this paper are correct, success or failure in the art of breeding will depend to a great extent upon the skill and judgment exercised in making a selection of breeding stock.

As all the characters of both parents are inherited by the offspring, a thorough knowledge of the qualities of animals and the tendencies of their organization in all its parts, will be required on the part of the breeder, to enable him to make a selection of desirable variations and at the same time reject all characters that may tend to interfere with the symmetrical and healthy development of the animal.

We have seen that the artificial conditions in which animals are placed, to secure the development of the special characters we seek, have a tendency at the same time to produce a delicacy of constitution and a defective performance of important functions.

Even if this unsymmetrical development of the organization does not proceed far enough to constitute actual disease, it becomes a predisposing tendency to disease that is liable to be made active by any slight causes.

If animals are selected that have a tendency to barrenness, and the conditions under which they are kept are such as to increase this predisposition, they will finally cease to breed, even if any approach to close breeding is carefully avoided.

Any defects that animals may possess will certainly become fixed by in-and-in breeding.

From the difficulty of detecting slight variations that tend to produce disease close breeding should not be practiced by careless or inexperienced breeders.

In the hands of those possessing the requisite knowledge and skill, however, it may not only be practiced with advantage when used as a means of accomplishing a definite object, but it becomes an essential element of success.

The opponents of in-and-in breeding seem to base their arguments upon the false assumption that those who defend it are in favor of the indiscriminate and promiscuous interbreeding of all of the animals of a herd or flock.

Such a practice would certainly be disastrous, and cannot be too strongly deprecated.

It does not, however, follow from this that it should not be practiced under any circumstances, or that it is in itself injurious.

If we would succeed in securing the highest possible development of our domestic animals, we cannot afford to discard any means that may be made use of, on the ground that it cannot be safely employed in the hands of the unskillful.

Slight variations in form and quality that are difficult to secure, may be fixed by a judicious inter-breeding of the animals possessing them when they could not be secured in any other way.

As a means of developing prepotency, it will perhaps be desirable to limit it, to the families from which we select males, so that they may have a predominating influence in determining the character of their offspring.

SUMMARY.

All distinguished breeders have practiced close breeding to a greater or less extent, and apparently with the same object,—to fix certain desired characters in their stock,—and to shut out all influences that tend to produce a variation from their standard of excellence.

Close breeding in itself considered, does not improve animals.

All characters of both parents are inherited by the offspring.

Close breeding fixes the dominant characters and gives prepotency in the transmission of those characters.

Animals are varied by the conditions under which they are placed, and the supply of food they receive.

The most desirable characters of our improved animals are highly artificial, and they adapt the animal to special purposes.

An excessive development of an artificial character in a special direction is usually accompanied by a modification of other parts of the system, and a certain delicacy of constitution.

The development of special characters with reference to a particular standard, gives rise to resemblances, which constitute family characteristics.

In attempts to engraft any new character upon a family, care must be taken to prevent a loss of the typical peculiarities of the family.

Close breeding does not in itself considered, injure animals.

Any defects arising from other causes will, however, be fixed and thus lead to injurious results.

The fat-producing breeds are more likely to show a tendency to barrenness, than those adapted to the production of milk or wool.

High fattening qualities are not favorable to the active exercise of the reproductive function. There is a close sympathy between the organs of lactition and those of reproduction—good milkers are usually good breeders.

The reproductive organs are sometimes affected by "fatty degeneration."

With high fattening qualities other functions may be impaired, thus leading indirectly to loss of fecundity.

Changes of food and habit will often interfere with the healthy performance of the reproductive powers.

The fact that many high bred animals are good breeders shows that close breeding does not necessarily cause barrenness.

Animals that are closely related may be separated and kept under different conditions, and thus prevent the development of precisely the same tendencies in their organization.

Too great a difference in the conditions under which the animals are placed, will, however, produce divergent variations that would tend to obscure the typical characteristics of the family.

A tendency to loss of fertility may be corrected by breeding within the limits of the family, if the characters of one parent are supplemented by the other,—a cross of color or of other unessential individual characters may sometimes be made with advantage on the same principle.

Success in breeding will depend upon the skill with which selections are made. If animals are defective in organization, or have a tendency to the feeble performance of any function from lack of constitution, their offspring will inherit the same peculiarities, even if they are not closely bred.

Close breeding in the hands of careless and inexperienced breeders cannot be too strongly discouraged, as it will undoubtedly result in fixing undesirable characters.

The highest success, however, can only be attained by those who possess the knowledge and skill required in fixing those slight variations of form and qualities, that make the nearest approach to the standard of perfection, by a judicious system of selection and close breeding.

As the influence of inter-breeding upon psychological characters has a more intimate relation to human physiology in its bearings upon social science, its discussion has been omitted in this paper, as it involves no additional principles of practical interest in stock breeding.

SOIL EXHAUSTION AND ROTATION IN CROPS.

The lecture of Prof. Johnson of the Sheffield Scientific School, is so valuable in itself and contains matters of such importance to the farmers of this State, that it has been decided to give the lecture in full in the present Report of the Secretary of the State Board of Agriculture. I have been requested by the President of the Board to write an article introducing the subject to the farmers of Michigan; yet it must be confessed that any thing from the pen of Prof. Johnson does not need any elaborate introduction to bring it to the notice of the intelligent public.

Cultivators of new soil are prone to deny that exhaustion of soil by cropping is possible, and we often hear them boast of the inexhaustible fertility of their soil. The Dutch settlers of the Mohawk Valley considered their soil so rich that the application of manure would be an injury and for some years carted their stable manure onto the ice of the Mohawk River, so that the spring flood might effectually relieve them of a useless encumbrance. The early settlers on the banks of River Raisin, held manure in about the same estimation, but did not often resort to the same means to get rid of it. The farmers on the western prairies still boast of the inexhaustible qualities of their soil.

If the owners of these rich lands would stop to consider that these virgin soils are in high condition, because that, practically, they have *lain in fallow for untold ages,*—that so far as cropping is concerned, they have not produced a crop which has not been returned to the soil for thousands of years, they will see that their present fertility is no proof that ultimate exhaustion may not follow.

Some writers have given an extreme definition to soil exhaustions, viz.: such a reduction of fertility that absolutely nothing will grow upon it. This is a barren soil, not an exhausted one. It is not possible, by cropping, to reduce a fertile soil to absolute barrenness. The definition of Prof. Johnson,—viz.: such a reduction of fertility that the soil will not produce a remunerative crop,—is the true one. A man may be exhausted by severe labor, but it does not follow that by food and rest he may not be able to perform any labor thereafter. So far as any immediate profit by cropping is concerned, it would be a matter of indifference to the farmer whether his land is exhausted or barren; but so far as any future productiveness is concerned, there is a wide difference between the two. By food and proper care the exhausted soil may be restored, while the barren soil is hopeless for any change. If his ox is exhausted by a hard day's work, hay and grain and rest may bring him up to the working condition by the next morning; but no amount of food and rest will bring his dead ox into working condition. Fortunately, in this country, we do not have to deal with a barren or "dead" soil, but our attention is directed to soils which are exhausted or capable of exhaustion by injudicious cropping.

The attention of scientific men has been directed to the subject of soil exhaustion for many years, and much study has been expended to determine what is the condition of an exhausted soil, to find the means of its prevention or removal.

THE HUMUS THEORY.

The first attempt to explain the nutrition of plants was founded on the analogy of animal life; that, as an animal may live in vigorous health while feeding upon the remains of another animal, so vegetable remains or the humus of the soil is the food of succeeding races of plants; and for a long time

King Humus was supposed to rule the vegetable world. This opinion is still entertained by some persons. Some time since a farmer who "believes in facts, you know, and dont want any of your theories," observing some shade trees on the College lawn mulched with saw-dust, exclaimed: "Now, that I call sensible, for you see you want to make *wood* in your growing trees, and this saw-dust is the very thing to make it of!"

But it was found that the mere presence of humus in the soil was not the sole condition of fertility, for a soil might be rich in humus and yet unfruitful, and that some soils would not produce grain because of an excess of vegetable matter, as is seen in our peaty swamps.

THE EXCRETORY THEORY.

The next theory was advanced by the great vegetable physiologist, DeCandolle, and was also founded upon analogy from animal life, viz.: That as all animals reject and cast out in their excrements those parts of their food which are not suited to sustain their organism, which excrements, while poisonous to this animal or class of animals, may be nutritive to animals of another class, so a plant rejected from the food materials absorbed from the soil those materials not suited to the growth of that plant, and by its roots threw off or excreted into the soil such rejected materials which would be poisonous to this plant or class of plants, while they might be beneficial to another class of plants. Hence, if wheat would not succeed after wheat, it was because the first crop had poisoned the soil by its excretions, while another crop, *e. g.*, clover, might not only not be injured, but really benefited by the excretions of the previous wheat crop. So also wheat would succeed after clover, being benefited by the excretions of the clover. The excretions of one crop were only injurious to the same or some allied crop, and were really beneficial to all other crops. If the ground were allowed to lie fallow for a season, these excretions became decomposed, and, therefore, would not injure a wheat crop, which might then be successfully grown.

This theory was very simple; it served to explain the advantages arising from rotation of crops, and the benefits secured by fallowing; and being supported by the great name of De-Candolle, it was the accepted theory for a long time. It was also strengthened by well-known analogies in animal life. Perhaps no mode of reasoning so readily leads one into error as reasoning from analogy when that common ground upon which the analogy must rest is entirely wanting. Animal life and vegetable life are remarkable for their contrasts rather than their resemblances.

Macaire of France resorted to some very ingenious experiments to demonstrate that plants do excrete or reject materials by their roots; but Braconnot afterward repeated these experiments under altered conditions and refuted his conclusions. Macaire found that when plants of Chondrilla Muralis are grown in rain water, they imparted to the water the smell and taste of opium; but Braconnot showed that this arose from bruising or breaking the roots when the plants were removed from the soil to be placed in the rain water. Macaire found that the euphorbium imparted a bitter taste, and gummy matter to water in which it grew; but Braconnot showed that this arose from the same cause, that the broken roots exude a white, milky juice, which causes the bitter taste and leaves a gummy matter when the water is evaporated. Macaire found that when separate portions of the roots of the same plant were immersed in separate vessels, one containing sugar of lead and the other distilled water, the lead could soon be detected in all parts of the plant and in the distilled water in which part of the roots were immersed, and hence concluded that the lead was excreted by these roots. Braconnot showed that the lead passed up the outside of the roots by capillary action and descended the outside of the roots into the other vessel; that when the roots were covered with an oily coating to prevent this capillary action no lead appeared in the distilled water.

Since these investigations by Macaire and Braconnot, Dr.

Alfred Gyde made some very careful experiments, from which he concluded that plants throw off by their roots only an exceedingly small quantity of organic matter, and that this is not injurious to the plants which furnish it. The conclusions reached by Prof. Johnson is the one now generally accepted, "In the light of newer investigations touching the structure of roots and their adaptation to the medium which happens to invest them, we may well doubt whether agricultural plants in the healthy state excrete any solid or liquid matters whatever from their roots." *

The excretory theory, therefore, is laid aside because it has no demonstrated basis in fact, and because it is inadequate to explain the facts involved in the rotation of crops.

LIEBIG'S MINERAL THEORY.

The theory which has attracted the greatest attention and provoked the most earnest discussion on the part of both practical and theoretical agriculturists, is the celebrated mineral theory of Liebig. In its first stages it may be considered as the natural rebound from the humus theory, which held that the vegetable remains in the soil, or humus, was the chief food of plants. Liebig satisfactorily refuted the humus theory, and showed that the chief supply of carbon for the plant was derived from the carbonic acid of the atmosphere, and not from the humus of the soil. His theory was grounded on the following propositions:

1. The soil being the only source of the ash elements of plants (*i. e.* those materials which remain as ash after the plant is burned), its only office (aside from affording mechanical support to the plant, regulating temperature and affording a reservoir of water), is to furnish these ash elements.

2. That the removal of these ash elements by plant growth diminishes by so much the productive capacity of the soil by diminishing its capacity to assimilate the organic elements which it may derive from the air.

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* How crops grow, p. 259.

3. That if these ash elements were again restored to the soil, its productive capacity would be restored to the same condition as before the crop was produced; if they were returned in greater amount, the productive capacity would be increased, if in less amount the productive capacity would be proportionately diminished.

4. That the capacity of any plant to form the carbohydrates (starch, sugar, woody fibre, etc.), was determined by the presence of alkalies, and its capacity to form the albuminoids (gluten, etc.), was in like manner determined by the presence of phosphates: the atmospheric supply of carbonic acid and ammonia was always sufficient for any crop, and consequently the formation of carbohydrates and albuminoids was determined by and limited to the supply of alkalies and phosphates available in the soil.

5. That the manural value of farm-yard manure was determined solely by the amount of ash elements they contained, and the benefits of farm-yard manure would be just the same if the solid and liquid excretions of the stock were first dried, then burned, and the ashes applied to the land.

6. That the manural matter necessary to produce any given crop could be ascertained with precision by burning the entire plant, analyzing the ash, and then combining the chemical substances found in the ash in such proportions and in such quantity as would furnish the ash elements for that crop.

7. That if these ash elements are supplied year by year, rotation of crops would be unnecessary, and we might raise a succession of crops of wheat for any length of time, and with no diminution in the yield, or exhaustion of the soil.

These are the principles essentially involved in his celebrated *Address to the Agriculturists of Great Britain.* Elsewhere he compares the ash elements of manure to the quinine of Peruvian bark, the iodine of burnt sponge, and the morphine of opium. Consequently it was the ash constituents that were the active elements of manure, and it was these that the farmer should apply to his land in order to increase the amount of produce.

These principles were stated so positively, appeared so plausible, and the results promised were so satisfactory, that, endorsed by the great name of the German chemist, they were received with great enthusiasm in Great Britain—the millennium of agriculture had come at last! A Scotch Laird, expounding this theory to his gardener, said: "The time is coming, Sandy, when ye can carry the manure for a whole field in your vest pocket." "And when that time comes, my Laird," replied the doubting Scot, "ye can carry the crop in your ither vest pocket."

Chemists were employed in making analyses of the ashes of different plants to determine the manures which should be employed for the increased and continuous production of these crops; large manufactories were erected to make these manures, and orders from all directions came in for "wheat manure," "barley manure," "turnip manure," etc. But when these manures came to be tried in the field, the result was a disastrous failure; and mineral manures and agricultural chemists became the scoff of the English agriculturists.

But while the application of Liebig's mineral theory of manures resulted in its complete overthrow, we are not to assume that the propositions of Liebig were entirely erroneous. "There is no error that has not some basis of fact." They contain some valuable truths which will yet bear fruit in agricultural practice. But the vigor with which he pushed a half-truth forced him into a false position—the great mistake of his scientific life.

Some person may object that I have only given theories which are acknowledged to be erroneous, and may ask what theory is now accepted in regard to the relations of plant growth to soil exhaustion. The phenomena of plant life, like those of animal life, are too complex to be stated in any "rule of three" theory. The proposition which is so often accepted, that the exhaustive influence of any crop on the soil on which it grows is measured by what the crop removes, is far from being self evident, and probably far from the truth. A soil of ordinary fertility taken to the depth of one foot will contain about seventy pounds of potash soluble in water to the acre. Yet by a crop of turnips we may remove two hundred pounds of potash from the acre and still leave more potash in the soluble form after the removal of the turnip crop than was originally present in the soil. In this case the exhaustive influence of the turnip crop is not measured by the amount of mineral matter removed, for the productive power of a soil is measured (so far as its ash food is concerned) by the amount that is left in an available form. The influence of the growing roots in producing chemical changes in the soil is a matter which has attracted far less attention than it deserves. Some very instructive results are given in Prof. Johnson's How Crops Feed, pp. 326-328.

The influence of the growth of any crop on a succeeding crop is measured not by what it removes, but by what it leaves behind in an available form. "The power of one crop to accumulate materials for the use and development of the succeeding crop, lies at the very basis of scientific agriculture."

LAND RESTING.

We often speak of the soil *resting*, and perhaps unconciously regard it as *weary*, just as an animal becomes tired by too continuous exertion. But the soil is just as incapable of weariness as the attraction of gravitation. We should regard the period of rest merely as the time when the plant is accumulating plant food by processes of chemical change in the material of the soil,—the period when the *reserve* elements of the soil become *active*, without subtraction by process of plant absorption or loss from any source. These processes of chemical change go on at all times, and if the materials thus made active are not removed by plant growth, they accumulate in the soil, and after a time the soil manifests increased power in promoting plant growth, just as an animal performs labor with increased power after a period of rest. The soil should not be regarded as an inert and changeless mass. It is the theatre of ceaseless activities, and without a constant succession of chemical changes, any soil, even the most fertile, would soon become permanently exhausted. It is by understanding, and when occasion requires, assisting these chemical changes, that we may prevent exhaustion of our soils. This is easy to say and hard to execute. The chemistry of the soil is obscure, and the very complexity of these changes makes the study a very difficult one. Chemical analysis gives but a meagre insight into this problem. We may try to solve this by direct experiments in plant growth, but the other factors then embraced—the influence of abundant or deficient water supply, of the season including greater or less amount of sunlight, atmospheric influences, the possible influence of ozone, etc., etc.,—should make us cautious about hasty generalization.

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SOIL EXHAUSTION AND ROTATION OF CROPS.

BY PROFESSOR S. W. JOHNSON.

Mr. Chairman and gentlemen: Some time since I received from Mr. Gold a letter asking me to address the Board of Agriculture, and the gentlemen assembled on this occasion, on Exhaustion of Soils and Rotation of Crops. In that letter Mr. Gold says:

"We want to go further than the common theory of rotation leads us, and inquire why some crops may be grown for several years in succession, as onions and buckwheat, why corn does not succeed after turnips, why does land become clover-sick?

"Why does the culture of certain crops tend to make the farm richer, while other crops only make it poorer, and in both cases, the gross amount of minerals and ammonia contained in the crops may be the same, or even greater in the enriching crops?

"Are there certain periods of plant growth which may be called the enriching period, and others, as the fruit season, the exhausting?

"Is not wheat, the prince of cereals, the greatest exhauster of the soil for the product taken from a given area?

"Tobacco should not be a very exhausting crop; yet from the fact, that for the particular purpose for which we cultivate it, a very luxuriant growth is required, do we not need to furnish more plant food than can be assimilated, much of which is lost in the air, and washes away?

"The physical condition of the soil as it is left by different crops is worthy of notice.

"Wheat grows well after peas and clover, also after tobacco; but is not this last owing to the manure left over by the tobacco and the good preparatory culture?

"Corn does not do well after buckwheat, but potatoes do well.

"Perhaps my facts may not be *facts*, but they are believed by a great many farmers, and we want the whole subject overhauled and explained."

After getting here on the ground, and looking over the material which ought to be considered in connection with these questions, Mr. Gold has promised me that I shall have another hour to-morrow, and I will occupy this morning with a part of the subject.

I cannot promise, however, to answer all the questions which Mr. Gold has proposed. Our knowledge is not sufficient for that. Mr. Gold's admission that some of his "facts may not be *facts*," shows that investigation is needed to establish fully what *is*, and to distinguish that from what *appears to be*, before we can reasonably expect to give explanations. But the very investigations which shall serve in any given case to identify the *fact*, will also assist in understanding the reason of it, and in seeing clearly its bearings upon the other facts which we properly regard as settled. I shall endeavor then, as far as the time admits, to put before you some of those considerations which seem adapted to furnish guiding ideas in respect to my subject.

By Exhaustion of Soil is properly understood, not a complete deprivation of producing power, but simply a reduction of this power below a profitable point. This is indeed a somewhat indefinite definition, because the point of profit is not easy to decide upon, but it is sufficient for our purpose.

What does exhaustion consist in? It consists either in the removal of certain materials from the soil, materials which serve to feed the crop and become a part of it, and which, by continually taking off harvest after harvest, become diminished in quantity, so that after a certain time there is not enough left in the soil to produce a fair crop, or else it means that the materials which may still exist in the soil no longer occur in that condition in which the crop can make use of them. We may have a soil containing potash in large quantities, many hundred pounds, or tons, even, in an acre, taken to the depth of two or three feet; but if this potash exists there exclusively as an ingredient of some mineral which is acted upon so slowly by the natural process of solution that there is no available potash, as we say, nothing which the crop can get hold of, such a soil would be unproductive. Again, we may have a soil which contains but a thousandth part as much potash, but which is fertile from the simple fact that the alkali occurs there in such a state as to become available as rapidly as the crop requires it.

To cure exhaustion, we must either restore the nutritive matters which have been removed from the soil, or we must change the state of those which still exist there so that they may become available.

Chemical science has established the fact that every crop requires a variety of materials to support it. I have here a number of printed sheets, containing a table of the average quantities of the chief ingredients of our ordinary cultivated crops, of which I would like every gentleman present to have a copy.

Average Quantity of Water, Nitrogen, total Ash and Ash elements in 1000 lbs. of fresh or Air-dry Vegetable Matter.

By Prof. Wolff, of the Agricultural Academy, at Hohenheim.

	Water.	Nitrogen.	Total ash.	Potash.	Soda.	Magnesia.	Lime.	Phosphoric acid.	Sulphuric acid.
Wheat, grain	148	20.8	17.1	5.5	0.6	2.2	0.6	8.2	0.4
" straw	141	8.2	42.6	4.9	1.2	1.1	2.7	2.8	1.3
Rye, grain	149	17.6	17.8	5.4	0.8	1.9	0.5	8.2	0.4
" straw	154	2.4	40.7	7.6	1.8	1.3	8.1	1.9	0.8
Oats, grain	140	19.2	26.4	4.2	1.0	1.8	1.0	5.5	0.4
" straw	141	4.0	44.0	9.7	2.8	1.8	8.6	1.8	1.5
Barley, grain	145	15.2	21.8	4.8	0.6	1.8	0.5	7.2	0.5
" straw	140	4.8	43.9	9.8	2.0	1.1	8.3	1.9	1.6
Indian corn, grain	186	16.0	12.8	8.3	0.2	1.8	0.8	5.5	0.1
" " stalks and leaves	140	4.8	41.9	8.9	1.2	2.6	8.8	8.8	2.5
Buckwheat, grain	141	14.4	9.2	2.1	0.6	1.2	0.8	4.4	0.3
" straw	160	13.0	51.7	24.1	1.1	1.9	9.5	6.1	2.7
Meadow hay	144	13.1	66.6	17.1	4.7	8.8	7.7	4.1	8.4
Red Clover hay	160	21.3	56.5	19.5	0.9	6.9	19.2	5.6	1.7
Timothy grass	700	5.4	21.0	6.1	0.6	0.8	2.0	2.8	0.8
Maize fodder, green	862	8.2	8.2	2.9	0.1	1.1	1.2	0.7	0.8
Red Clover, green	800	5.3	18.4	4.6	0.2	1.6	4.6	1.3	0.4
Potatoes, tubers	750	8.2	9.4	5.6	0.1	0.4	0.2	1.8	0.6
" tops	770	4.9	11.8	0.7	0.1	2.7	5.5	0.6	0.6
Turnips, roots	909	1.8	7.5	8.0	0.8	0.3	0.8	1.0	1.1
" tops	898	8.0	14.0	8.2	1.0	0.6	4.5	1.3	1.4

Table of Average Quantities—Continued.

	Water.	Nitrogen.	Total ash.	Potash.	Soda.	Magnesia.	Lime.	Phosphoric acid.	Sulphuric acid.
Carrots, roots	860	2.1	8.8	8.2	1.9	0.5	0.9	1.1	0.6
" tops	808	5.1	26.1	8.7	6.0	1.2	8.6	2.1	1.5
Hops, entire plant	250	.....	74.0	19.4	2.8	4.8	11.8	9.0	8.8
Hops, the cones	120	.....	59.8	22.8	1.8	2.1	10.1	9.0	1.6
Tobacco	180	46.0	197.5	54.1	7.8	20.7	78.1	7.1	7.7
Stable manure	750	5.8	69.1	6.8	1.5	1.7	6.8	8.2	2.8
Dungheap liquor	982	1.5	10.7	4.9	1.0	0.4	0.8	0.1	0.7
Fæces, fresh	772	10.0	29.9	2.5	1.6	8.6	6.2	10.9	0.8
Urine, human, fresh	953	6.0	18.5	2.0	4.6	0.2	0.2	1.7	0.1
Night soil, fæces & urine fresh	935	7.0	14.0	2.1	8.8	0.6	0.9	2.6	0.4
Bone dust	50	40	608	.....	....	7	818	257	....
Nitrate soda	20	150	980	.....	836	1	1	.....	11
Sulphate ammonia	50	200	950	.....	....	.....	.....	.....	550
Fish guano	76	78	219	.....	....	.....	76	72	....
Ground kelp	98	12	211	22	44	12	11	8	68

To give an illustration with one of the substances which is absolutely essential for vegetable growth, I will take sulphuric acid, the proportions of which in 1000 lbs. of our ordinary crops are given in the last column of this table. Sulphuric acid, in the form of some sulphate, must be present in the soil. If we should remove all the sulphates from a given soil, it would be totally impossible to grow any crop or any plant there unless the sulphates were replaced. That is one of the first principles of agricultural science, which applies equally to all of the ingredients stated in the table, with the possible exception of soda, as has been established by such an amount of experimental evidence that there can remain no doubt of it whatever. Sulphuric acid, or the sulphates, as they are found in nature, are very liable to be removed from the soil. The sulphate of lime is the form in which sulphuric acid chiefly occurs in land. This dissolves in about five hundred times its weight of water; and where the soil is so situated that heavy rains fall upon it, leach through and go out of it again, the sulphuric acid is rapidly washed away. Almost everywhere, except in the poorest soil, you find the water a little hard, when you use it with soap. This hardness is due to the presence of lime, and in most cases you find the water contains a little sulphate of lime, which is the same as plaster of Paris. This continually dissolves from the soil and passes into the springs and rivers. If the soil is not porous, but of such a nature that it can hold the rain which falls upon it to a large extent, the case is different, and the loss is not so rapid as from soil where the water runs freely through; but we have in this way a constant loss of sulphuric acid from the soil.

Unless there is an unfailing supply of sulphates in the soil itself, furnished, for example, by the chemical alteration of some other sulphur compound, as iron pyrites, there will in time come to be a deficiency of sulphuric acid from this washing process alone, and although this element of crops is the least prominent of them all in respect to quantity, it is likely to be soonest exhausted. The moment when the available sulphates in the soil become less than is required for a full crop, it will be impossible to realize such a crop without making good the deficiency.

The soil in a given case may be unfertile, may become exhausted, simply because this one ingredient is removed by the processes of washing and cropping. Lime and soda are also washed out from the land, slowly to be sure, but continually, and in quantities whose aggregate is very large. There are other elements, like phosphoric acid, which we do not lose by washing to any appreciable amount. You do not commonly find this substance in the water of wells or springs, except in the minutest quantities. It is very rare to detect it in waters, except those which have passed through a very heavily manured soil, or unless it is otherwise especially abundant. Potash, for another example, rarely wastes from the soil, unless it is from light, coarse, sandy land having but little fine material in its tilth.

If the substances which feed the crop, one or all, have become reduced in quantity or are not in proper condition as to solubility, we may remedy the exhaustion either by applying the materials in the form of some fertilizer which contains them, or we may omit that, and rely upon those processes by which the original rocks of the earth's surface have been converted into nutritive soil; the processes by which those substances, once totally unavailable for crops, have been made available. We can wait the operation of the natural agencies which are involved in what we call "weathering;" the action of water, and of the carbonic acid and oxygen in the air. When we leave land in fallow—a thing which is practiced much less now than formerly—these processes go on in the soil, and prepare a quantity of plant-food for the crop of another year. This "weathering" process is in constant progress, and is of great importance in supplying the materials which our crops demand. If that process should be suspended, farming would become a very difficult business. That certain fields will produce crops of the same kind for years and years without any fertilizing addition whatever, is due to the fact, that as fast as the crop requires and removes the materials given in our table, they are supplied by the soil itself; they exist in the soil, were originally stored up there, and they are made soluble day by day, as the crop may need. The rate at which this weathering process goes on, determines, other things being equal, the natural yield in a given case. By active tillage, throwing up the soil, so that it is exposed more fully to the air, and by drainage, if this be necessary to ensure access of the atmosphere, this process can be hastened. Most saline fertilizers, such as common salt, nitrate of soda, superphosphate of lime, and plaster of Paris, also act in a similar way to dissolve the elements of the soil, and thus prepare them for the crop;

so that, although these fertilizers may in some cases do nothing towards feeding the crop directly, they help to feed it by this indirect action in dissolving and bringing into an active form the materials which the soil contains in abundant quantity but in an inert state.

To go back and review, in a couple of statements: Exhaustion is the reduction of the producing capacity of the soil below the point of profitable cultivation, and depends either upon the absolute removal of certain materials, or their removal to such a point that the supply is below the demand of the crop, and such removal of materials must be compensated either by suitable fertilizing applications or by making the unavailable materials still present in the soil available by fallow, tillage, etc.

Mr. Lawes, of England, a gentleman who has devoted a great deal of attention to agriculture, and spent a great deal of money in its study, and who has arranged the most beautiful and elaborate field experiments that have ever been made in any country, has brought out, in a recent publication, the distinction between the "natural strength" of the soil and what he designates its "condition;" and as this distinction is an extremely important one, I will devote a few moments to its consideration. The natural strength of a soil is its feeding power and adaptedness to crops in all those respects which belong to the soil by its original nature. This standard fertility or productive power is something characteristic of the soil, something you cannot separate from it, something belonging to its entire mass and dependent upon its original composition, texture, and properties. It is a thing which lasts a long time, and perhaps has scarcely any limit in the matter of duration, whatever may be its limit in the quantity of crop which the soil will produce. Every soil has its natural strength, greater or less, the degrees covering a very wide range. You have all heard of soils which are remarkable for their productiveness, or for their want of productiveness. The valley of the Nile, for instance, is a region which has been cultivated for a period longer than history can define with any accuracy, and produces large crops annually of the most exhausting kinds.* Wheat and similar grains are grown there continuously, year after year, without any attention, except digging in the seed, watering, and taking the crop off. We find in Hungary and Southern Russia large tracts of country where, every other year or every third year, large wheat crops are harvested. The land is cleared, the seed put in, and after the crop is gathered the land is allowed to rest one or two years, then another crop is put in, and so on. This process has been going on for centuries. Black Sea wheat is famous all over the world. The export of wheat from those southern districts is immense. Until our western country came into bearing, that was the chief source of the wheat-supply to continental Europe.

We have in our Genesee region, in central New York, a country where the soil is of remarkable natural fertility, and, after the first few years of cultivation, the farmers fell into a routine which enables them to take off wheat crops every third year, right along, with great uniformity. The uniformity is great, at least so far as it depends upon the feeding power of the soil. Accidents, like the rust, the midge, or something of that sort may come in and destroy their crops occasionally, but the feeding power of those soils remains, as a certain quantity, and will probably so continue for a great length of time.

The most interesting case which I can bring up in illustration of the natural strength of soil is furnished by the English gentleman to whom I have referred, Mr. Lawes. In April, 1870, he wrote, in respect to a field on his estate, a paragraph as follows:

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* A possible explanation of the continuous fertility of the valley of the Nile may be found that at the annual inundation of the Nile, a deposit of fresh soil is made, so that year by year a virgin soil, in part at least, is used in raising the crop. The same condition is found in the basin of the Ganges, and in the river bottoms of our own country. The remarkable fertility of the bottom lands of the river Raisin springs from this annual dressing of new soil received in "the spring freshet." K.

"The same heavy loam, of no extraordinary fertility, has yielded an average annual produce, without any manure at all, of 16 bushels of wheat for twenty-six years; 20 bushels of barley for eighteen years; and nearly 24 hundred weight (long hundred weight), of hay for fourteen years."

Mr. Lawes began, in 1844, to see what would be the effect of putting a given plot of land into the same crop year after year, with no manure whatever; and the result is what I have just stated. These averages which he gives are, with one or two exceptions, the regular yield, within two or three bushels, of this piece of land. A field, for example, which has been this last summer, twenty-eight years in continuous cultivation under wheat, has averaged about 16 bushels; on one occasion it went up to 23, and one occasion it dropped down to five, These variations were due to the season, but otherwise the yield ranged between 12 to 17 bushels, so that this productive power of 16 bushels may be considered as the capacity of that soil in respect to the wheat crop. I do not see any reason why he and his successors should not go on for a hundred years and get the same amount of wheat, within about the same limits. Perhaps it would fall off somewhat. There is a little falling off in the last half of the period just completed. The yield is perhaps a bushel less than during the first half; but that may be accidental, and due to the character of the seasons. There is no reason in my mind why, for the next twenty-five years, the yield should not be a bushel or two more; but we have not lived those other twenty-five years, and we cannot tell positively.

The worst soil we can point out has a certain natural capacity. Take our rocky hill ranges in this State: if we should give a little care to them we could harvest every twenty-five or thirty years a certain crop of wood from them; and if we should begin that culture now, and carry it on for a hundred years, we should get the same crop the last thirty years that we did the first thirty. If we carried it on for a thousand years, the climate and circumstances generally remaining as they are, we could depend upon getting from them three uniform wood crops every century. So in the poorest pasture, we have a certain natural productiveness, which remains the same, so long as the state of the soil is unaltered. The field may become a swamp, or its natural water supply may be dried up by local changes, but independently of accidents like these, it will manifest a certain nearly uniform natural strength from generation to generation. All production of vegetable matter in the soil of any kind is the result of change—the result of chemical and physical change. Natural strength depends upon changes in the soil, which act in a nearly invariable manner for long periods of time. The "Tooth of Time," is an expression belonging indeed to figurative literature, but one also fully justified by fact. It is a tooth whose action never ceases, and whose sharpness is never blunted. The grand rock-ridges and peaks which make the mountains of the globe, although they have held their crests aloft in flinty defiance through all the periods of human history or tradition, are slowly wasting under its incessant bite, and the explorer in the high Alps hears from hour to hour the thunder-like noise with which huge blocks of granite, loosened from the mountain tops, crash downwards. At the base of any high cliff you may see a *talus* of sharp angled stones reaching half up the breast of rock, unless some rapid stream of water or slow-pushing glacier is there to carry them away. Our level fields are or have been covered with lumps of rock, and our soil is full of them, but these are not sharp-edged as if just struck off by a hammer-blow, but they are rounded in all their outlines; the "Tooth of Time" has not ceased to eat away at every angle and corner of these tempting morsels, as the teeth of children gnaw at sugar plums. Nor does the work stop here. As they lie out on the pasture or buried in the plow-land, the same invisible tooth nibbles at every point of their surface, roughening and corroding them until they are reduced to dust. Even the sand-grains are ever cut smaller and finer until they dissolve away from our sense of sight or feel, and the long imprisoned potash and lime, the phosphates and the sulphates, are released.

It is the "Tooth of Time" which thus levels mountains and crushes boulders into soil, and it is the same tooth whose incisive workings in the soil reduce the elements of the rocks to the impalpable state of food for the plant. Where circumstances remain the same, these changes prepare the nutriment for plants at a certain regular rate, and the natural strength of the soil is simply the expression of this steady development of plant-food and the corresponding production of vegetable matter.

To turn now to what Mr. Lawes calls the "condition" of the soil. Farmers are in the habit of saying, "This land is in poor condition"—or, "This is good soil, but it is rather run down; it is in poor condition at present." Or, looking over the fields of a neighbor, who has taken a little extra pains, "This is poor land, but he has got it up into good condition." "Condition," then, is artificial or accumulated strength; a thing we cannot depend upon, except as we can depend upon the continuance of the artifice or temporary causes of which it is a result. "Condition" refers to those elements of fertility which are capable of being turned to account in the growth of crops within a limited time. We may have a "condition," which is the result of natural causes, as is illustrated by the manner in which Indian corn is grown in some part of South America, on land newly cleared from the forest. You know that in tropical latitudes the year is usually divided into two seasons—the wet and the dry. During the former, abundant rains fall, and vegetation grows with wonderful luxuriance The other half of the year is comparatively dry, and plant-life is inactive. At the close of the rainy season the planters chop down the timber, the brush, and every thing that grows upon the land where they propose to get a crop. When the fallen vegetation is sufficiently dry, they set it on fire, and everything burns completely except the largest trees. When the fire has gone out, toward the beginning of the next rainy season, they have a field destitute of vegetation, and coated with the ashes of the forest. There, with the smallest preparation, they plant their corn in the ashes, dropping it in where they can, and get a magnificent crop. The second year they put on corn again, and get another large crop. The third year they get another crop, and after that it is cheaper to abandon that field and to clear another. The first piece grows up to forest, and in six, eight or ten years, perhaps, they can burn it over again. Here, the fertility of the soil after burning is a "condition" which is produced partly by natural means, the growth of the forest, which brings up matters from below, and partly by artificial means, the felling and burning of the forests, restoring those matters to the surface.

"Natural strength" is something which is comparatively unaffected by cropping. Where the soil has great natural strength, you cannot permanently exhaust it; you may get it down to a point where production is unremunerative; you may say your land, once good, is "exhausted," but a skillful farmer will take hold of it, and by the use of some judiciously selected fertilizer, and the application of well-directed labor, he will bring up this exhausted soil in a short time, and make a profitable farm of it. It only needs a little "condition" to re-establish its good name. "Condition" itself, however, is a thing which is easily run through with. You may take a poor, light soil, and make it productive by the application of manure and by careful tillage, but if you stop there and undertake to work on that capital, you will find that it deteriorates rapidly. You will have to come down to the natural strength, and if that be small, your crops will correspond.

To illustrate further what "condition" means, take the case of those fields of Mr. Lawes, the natural strength of which was measured by a yield of 16 bushels of wheat, or 20 bushels of barley, or 2600 lbs. of hay, through a number of years. He took a portion of that land and put on it annually fourteen tons of yard manure to the acre, and during the nineteen years in which he carried on that process simply, he got 36 bushels of wheat per acre, as the average, some years a little more and some years a little less, and one or two years a good deal less than this quantity, on account of some peculiarity in the season. On another field of the same land, where he put four hundred pounds of ammonia-salts—sulphate of ammonia, I believe, mainly—he also raised annually 36 bushels of grain. On another field, where he applied forteen tons of stable dung, he got 48 bushels of barley, on the average, for nineteen years. The annual use of stable manure in this quantity, and the annual addition of a certain number of pounds of salts of ammonia, raised the crop of wheat from 16 bushels to 36 bushels, and kept it steadily at that point for nineteen years; so that the difference betweed 16 and 36 bushels—that is 20 bushels, was the crop which was produced from that field by the use of fourteen tons of stable manure in one case, and four hundred pounds of salts of ammonia in another. It was the stable manure and ammonia salts in those quantities which improved the "condition" of the land by the equivalent of 20 bushels of wheat.

We understand then, that there is a natural quality in the soil which we cannot easily bring below a certain limit; and there is a "condition," an artificial, temporary or adventitious fertility, which we can easily increase and easily exhaust.

There are many circumstances which necessitate or justify a *rotation of crops.* I will not attempt to enumerate them all. Differences of soil and climate, the quantity of fertilizers accessible, the demand in the markets, ease of transportation, politicians, when they make fluctuating tariffs, weeds which come to infest the fields, insects even, may make it advisable to alternate our crops. It may not be uninstructive to go back in history and give a sketch of the gradual development of the practice of Rotation.

The earliest husbandry was simply pasturage. When the people of temperate climates found they could not support themselves by killing wild animals and gathering fruits, the natural produce of the country, they began to tame animals, and keep herds of cattle, sheep, etc.; and you know that on the vast plains of Asia, and South America, this sort of pastoral husbandry is still the only one known. As population became more dense and land more valuable, people crowded each other, and there was not room enough to roam about at will, and settle upon pasture wherever it could be found, unless for a change, the people fell to fighting, and partially killed each other off, thus leaving land enough for the survivors. When civilization began, it became necessary to cultivate forage crops, or at least to take some care of the natural meadows. The next step was to assist these natural resources by growing some grain, and people began to break up a little land and cultivate wheat and the various grain crops; afterwards, attention was given to root crops. It may not be possible now to show how these steps of progress have taken place in any given locality; but this is a general history of the development of husbandry all over the world, wherever it has attained any perfection. Farmers have always carried on their operations in a very simple way, at first for many generations. On the continent of Europe, where we have the most authentic accounts, they plowed a small portion of land, and grew some grain upon it,—barley, wheat, or rye,—putting in the same crop as long as they could make it grow and get back a little more than the seed. They were content with much poorer crops than we regard profitable. They used the same land for several years, until its "condition" was gone, or until it was no longer remunerative, and then they left it and plowed up another piece. The old field would grow up to grass, and after a number of years they would come round to it again and sow it to grain. That was the earliest and simplest plan of conducting farming. In those days, there was but little skill or thought bestowed upon agriculture. The intelligence of the world was mainly given to government, war, and things of that sort. The peasant was a man who knew nothing except to grub the ground, and he did it year after year, generation after generation, as his father had done it before him, with little idea of change or improvement. In the neighborhood of cities, where there was better pay for this kind of work, and more intelligence concentrated upon it, of course it began to be found that a little rotation was a good thing. Where rotation started, we do not know. In some books it is stated that it was invented in England. But if you will read Virgil and Varro, you will find that the Romans were well acquainted with rotation, although Virgil, who was a poet, only mentions it in an incidental way. Leaving the results of modern science out of the account, there is not much in our agricultural practice that you will not find described in Latin books. Those people, who developed a magnificent civilization which they forced upon the unwilling savages of Britain and the north of Europe, who were our ancestors, did a great deal of good work in the way of agriculture, considering the facilities at their command.

After a time, there came into use in Europe a system which was practised there extensively in the ninth century and is still followed in some parts of the continent. It was known as the three-course system of rotation. For centuries this system was carried on where the farmer had large pasturage, and little plow-land. The first year, the plow-land was left in fallow, but in the autumn was prepared, by what manure and rough tillage could be given it, for a sowing of winter grain, mostly rye, which occupied the second year. The third year the ground was put in summer grain, which completed the shift. Then the farmer began again, with a year of fallow and manure, a year of winter grain, a year of summer grain; and so he went on—three years—three years—three years—indefinitely. I suppose there are districts in

Europe that could be pointed out where this practice has prevailed for nearly a thousand years, and it was early imported into this country. It was the subject of legislation in the time of Charlemagne. Some historians think that this monarch decreed the adoption of the three years shift; others think that he merely recommended it, as an improvement on what had been previously the custom among the less advanced peasants, of simply using the plow for a succession of years without any rest for the land. In the vicinity of cities, where the plowed land increased in proportion to the quantity of pasture, and the supply of dung became inadequate to manure it sufficiently, so that the manure and fallow together could not make two good grain crops, forage plants—grass, clover, or roots—were introduced into the course; and in that way, a great variety of rotations came into use.

In England, there has been practiced, over a considerable part of the country, what is known as "the Norfolk rotation" —a four years shift. You have all read of it, doubtless. The first year, clover and mixed grass seed; the second year, wheat; the third year, turnips or rutabagas; the fourth year, barley; and then the same course again, with, perhaps a little variation; perhaps the land was kept two years in clover and grass. In Dorset, Wilts, Essex, Herts, Suffolk, and Cambridge, in England, ten or fifteen years ago, this course was in almost universal use. I speak of this matter to bring up one point. There are certain advantages in rotation which, being observed or conceived, led to its adoption. But farmers, especially in long-settled countries like England, are apt, having once accustomed themselves to a routine, to adhere to it long after its advantages cease to exist. This is illustrated by the fact that Norfolk, which gave England the four-course system just described, began more than thirty years ago to amend its own improvements. The command of concentrated and artificial fertilizers which admit of easy application at any point in a rotation, led some of the best farmers there to introduce another grain crop—oats—into the shift, making a five years course, and according to Caird, in his "English Agriculture," "on a large farm where this system has supplanted the four years course the average produce of all the grain crops has increased in ten years between thirty and forty per cent; the extent of land on this farm in wheat, having during that period annually increased till it has now (1850–51) become one-third greater than it was then."

In Great Britain, Germany, and other European countries, you will find in many localities very complicated systems of rotation, I saw the other day, in a book which I was looking into for some statistics, a long and curious calculation, showing the various materials—lime, potash, phosphoric acid, etc. —taken off and put on a farm, which was divided into ten equal fields, and each of these fields, went through successively with the same ten years' rotation; which was: 1, Summer Fallow, manured. 2, Winter Coleseed. 3, Wheat and Rye. 4, Legumes, manured. 5, Rye. 6, Potatoes. 7, Clover and grass. 8, Clover hay. 9, Pasture till 1st July, then summer fallow. 10, Rye and Wheat, "half manured."

It is a great advantage, in the conduct of a large estate of four or five hundred acres, to have the whole system of cropping made up beforehand, so that the men can tell just what is to be done from year to year. The management of farm labor is simplified by this arrangement. That is one of the reasons why such complicated rotations are adopted.

It should be well borne in mind that while there are circumstances in which rotation is extremely advantageous there are other circumstances under which it is comparatively unimportant. Certain conditions make rotation necessary, and others make it unnecessary. There are two kinds of agriculture, which have been defined as "extensive" and "intensive." The "extensive" is where land is cheap, and where capital, labor and manure are scarce. There the farmer must go over a great deal of surface, and depend chiefly upon the natural resources of his farm,—getting out of it what he can, "by hook or by crook." "Intensive" agriculture is where the circumstances are such that the farmer uses a comparatively small quantity of land and a large amount of capital, is able to get fertilizers in abundance, and sells his crop quickly and at a good price. He puts a great deal more into the soil and gets a great deal more from it than his "extensive" brother. He works in a more *intense* way. That is, his labor, instead of being spread over two hundred acres, is concentrated on fifty, and he is able to make his fifty acres more profitable than the other farmer can make his two hundred. In "extensive" agriculture we usually have a large quantity of pasture and keep a good many cattle, for we have to depend largely on their manure. We have to sell off a large share of the crops, which remove valuable materials from the soil, and we cannot or do not buy fertilizers to make good the deficiency. In the other case, the farmer can put in as many fertilizers as he chooses to pay for. He is able to buy them, and he finds his profit in using them. In "extensive" agriculture, which is made necessary by circumstances, the farmer must depend largely upon rotation; he must bring it into successful use. As he succeeds or fails to do this he carries on a paying or a losing business. In "intensive" agriculture the farmer is largely independent of this necessity; he can rotate or not, very much as he chooses. Rotation is not indispensable to his success. That is, the advantages that come from rotation are not so great as the other advantages which the farmer has at command by the use of plenty of money, plenty of fertilizers, by his nearness to market, and high prices.

Now, I wish to state some of those principles which should govern us in rotation, so far as this depends on what we may call the chemistry of the crop and the soil. So far as the feeding power of the soil is concerned, the special requirements of the crop should determine the rotation. Of course there are other conditions to be taken into account in practice. Winter wheat, for example, cannot follow itself beyond a certain length of time, even if the soil will allow, because the land ordinarily becomes foul with weeds; and it is better to alternate with some crop which will enable us to destroy the weeds by hoeing or which will choke them out directly. There are many conditions which influence rotation that I do not propose to speak of, but I shall confine myself to that part of the subject which is involved in the feeding of the plant. The broadest principle of rotation is to alternate grain crops with forage crops. That is, to follow plants having a short and rapid growth and which produce seed, by plants of a longer period of growth which are not allowed to ripen seed, but are harvested for their large amount of foliage.

Plants, like animals, have different ways of feeding. If you were to undertake to keep a dairy of hyenas you would have to provide a different food from that which you give to cows. If you should choose the giraffe as a domestic animal you would find that its habits of feeding are adapted to very different circumstances from those of your common pastures. The natural food of the giraffe is mainly the buds and twigs of a kind of locust tree that grows in the African wilderness, and the long fore-legs and long neck of the animal are shaped for browsing among the tops of those trees. The different classes of plants have peculiarities in their feeding arrangements which are as marked and striking as these differences in animals.

On comparing together the roots of our ordinary crops, we find that when they grow under similar circumstances there is a great difference in the depth to which they extend, a great difference in the degree in which they branch, and a great difference in the absolute quantity of roots. Unfortunately, we have not enough really satisfactory observations on these points to serve us in any very extended comparison, it being rather troublesome to make accurate observations of the roots of plants when they have once penetrated the soil. A few brief paragraphs in my book "How Crops Grow," embrace pretty nearly all we know about this matter of the growth of roots. As to depth, Schubart has made the most satisfactory observations we possess on the roots of several important crops growing in the field. He separated them from the soil by the following expedient: an excavation was made in the field to the depth of six feet, and a stream of water was directed against the vertical wall until it was washed away, so that the roots of the plants growing in it were laid bare. The roots thus exposed in a field of rye, in one of beans, and in a bed of garden peas presented the appearance of a mat or felt of white fibres to a depth of about four feet from the surface of the ground. Roots of winter wheat were observed as deep as seven feet in a light sub-soil, forty-seven days after sowing. The depth of the roots of winter wheat, winter rye, and winter coleseed, as well as of clover, was three to four feet." Schubart further collected and weighed the roots of wheat, rye, and peas, and ascertained their proportion of the entire plant. Hellriegel has also published some observations on the extent of the roots of barley and oats.

We have a few other observations of this sort, but not enough to enable us to determine the comparative quantity and depth of the roots of our cultivated plants with any accuracy. It will not do to draw conclusions as to the length of roots from such observations as these, made, it would appear, in different soils, differently treated and fertilized, because other observations show that the development of the root depends not exclusively upon any impulse which it receives from the plant (that is, the root must not necessarily weigh so much or measure so much), but depends also upon the nature of the soil. Where this is rich the roots tend to remain; they branch and ramify through all the pores of a small bulk of earth. Where this is poor they stretch off and are sparsely distributed through a larger space. Where they find plenty of food they grow and multiply upon it; where nourishment is lacking they seem to go in search of it. All observations must, therefore, be comparative. We know, however, in a general way, that the development of roots is different in different classes of plants. We know that clover has a much deeper system of roots than our ordinary grains. We know that where the soil is rich at the surface, and where it is adapted naturally, by its mechanical condition, to the growth of wheat, for example, the large proportion of wheat roots are found within a rather narrow space. On the fertile plains surrounding the town of Leipzig, the principal commercial city of Saxony, situated in one of the richest agricultural regions of Germany, I have seen the same kind of plow going back and forth, which you will find pictured in the classical dictionaries as used by the Romans. If you should take a shingle five inches wide and sharpen it to a blunt point, you would have about the shape of the plowshare I refer to.

This wooden instrument, shod with thin iron, did not turn a furrow; it simply made a groove about four inches deep from crest to base, stirring and mixing the soil thoroughly, however, to that extent. This was the only kind of plowing I saw practiced on these fields in 1854, and yet splendid crops were harvested from them. The soil was doubtless naturally of excellent texture and allowed a due penetration of the roots.

But the fact remains that with such tillage all fertilizing applications must remain near the surface, and this makes evident that the roots of our grains need not go down to any very great depth. If the soil has nourishment and moisture for them, six or eight inches of earth will answer for the support of a crop. A foot will, in a majority of cases where the soil is of good quality, contain the bulk of the roots of the wheat crop. They may go deeper, as Schubart observed, but only because they must descend in order to find food or drink. It has been shown by experiment that roots develope in poor soil in the vicinity of any enriching material; so that we cannot say, because Indian-corn roots have been traced for twenty feet in a sand-bank, that it is the habit of the maize plant to send out roots twenty feet long. The length depends upon the soil rather more than upon the plant.

It is greatly to be desired that our knowledge of the relative development of the roots of our various crops should be completed. The roots are in one sense the most important part of the plant. We cannot influence a field crop, except through the roots. We do not manure the tops, or operate upon them in any way. All our efforts to promote growth must be directed to the root, and yet we do not know with precision what is the extent and depth of the roots of the wheat plant, for example, as compared with the roots of any other plant. We simply know that some plants have more and longer roots than others; that clover, for instance, is deeper rooted than wheat.

Some important contributions to our knowledge of this subject have been made quite recently, and I have placed upon the blackboard some figures obtained by chemical analysis of the residues of certain crops; i. e., the stubble, and the roots down to the depth of ten inches. At Proskau, in Prussia, there is a Government Agricultural School, and Dr. Weiske, one of the chemists connected with that school, a year ago last summer, measured off certain plots of land, several yards in dimensions, and carefully excavated the soil to the depth of ten inches and with extreme pains dug out all the roots he could get in that depth of soil. These he dried, weighed, and analysed, and these figures show the average of his results, calculated in pounds upon the surface of an acre. Unfortunately, he did not state any thing about the quantity of the crops; but from the fact of their growing at Proskau, where the soil has long been under cultivation, it is to be presumed that these crops were good.

COMPOSITION OF ROOTS AND STUBBLE.—Lbs. per acre.

	Dry veg. matter.	Nitrogen.	Lime.	Magnesia.	Potash.	Soda.	Sul. acid.	Phos. acid.
Rye	3400	62	69	14	80	40	12	24
Barley	1515	22	40	5	9	8	5	11
Oats	2200	25	81	12	24	17	8	28
Wheat	2240	22	72	10	17	11	7	11
Red Clover	6580	180	246	46	77	19	24	71
Buckwheat	1630	45	75	7	9	4	6	10
Pea	2400	58	68	11	11	7	9	14
Lupine	2800	53	76	12	16	3	7	13

The first column gives the amount of vegetable matter which was contained in the roots and stubble. We are not informed what the height of the stubble was; probably it was rather short, as straw is too valuable in most parts of Prussia to be left on the ground. These figures were obtained to throw light on what happens under the circumstances that prevail in the culture at Proskau. We want a similar work done to throw light on what happens under our circumstances, and this work should be repeated several years, so that we shall arrive at average figures that can be fully depended upon. Referring to the table, you have of rye stubble and roots, 3400 lbs.; of barley, 1515 lbs.; of oats, 2200 lbs.; of wheat, 2240 lbs.; of red clover, 6580 lbs.; of buckwheat, 1630 lbs.; of peas, 2400 lbs.; of lupine, 2800 lbs.

You see at once the bearing of these figures. You see that when you have got your clover hay off the field, there remains, within ten inches of the surface, twice as much vegetable matter as is necessary to go into the next rye crop, and three times as much as is necessary to go into the next wheat crop. That helps to explain why clover is a good preparation for these crops. Look at the column headed "Nitrogen." In rye, we have 62; in wheat, 22; in clover, 180 lbs. Take lime:

in rye, 69; in clover, 246; and so on. What I want to show mainly by this table is expressed in the first column of figures—the amount of vegetable matter remaining in the roots.

Here we have another set of figures which refer somewhat in detail to two of our standard crops—Rye and Clover:

	Roots. av. length.	Top. weight.	Roots. weight	Ratio of Root to Top.
Rye, before heading	6 inches.	50	30	10: 17
" headed	8 "	106	23	10: 45
" in bloom	8 "	148	24	10: 59
" ripe	8 "	258	19	10: 136
Clover, before bud	18 "	56	35	10: 16
" in bud	16 "	94	50	10: 19
" in blossom	14½ "	106	45	10: 23
" ripe	15 "	147	99	10: 15

In this experiment, due to Heiden, a mass of soil, one foot wide, five feet long, and four feet in depth, was enclosed in boards, then lifted out and the roots removed by careful picking and washing. The average length of the roots was noted, and the total weight of roots and tops ascertained. This was done, as the table shows, at several different periods of growth.

You see from the second column that the roots of rye at the time of heading, had an average length of eight inches, and did not gain anything beyond that. In the clover, at the time of budding, their length was eighteen inches; in bud sixteen inches. That looks like going back; but you must remember that the roots measured in the one case were not the same roots as those measured in the other, but were from another plot of ground. In blossom they were fourteen and one-half inches; when ripe, fifteen inches. The grand result is simply this: That wherever rye roots were eight inches, clover roots were twice that length; and this in soils which I suppose were quite similar in character. That is a piece of information of great value.

Mr. Lyman. I have heard old men express the opinion that the principal benefit of clover arose from the large amount of root which is left in the ground, even after it is plowed under. I suppose that to be the fact.

Prof. Johnson. Undoubtedly so.

Mr. Lyman. If we grow a plant which has a very small root, of course the vegetable matter, to supply the succeeding crop, is comparatively small.

Prof. Johnson. I have heard old farmers, and young ones too, say that they would give more for that part of the clover crop below ground, than for the part above ground. You have here an accurate setting forth of the proportions. Look at the figures which represent the weight of the top and of the roots. You see there is a rapid increase in the amount of top in the rye plant—from fifty up to two hundred and fifty; but you observe that the absolute amount of roots diminishes. Whether that is due to any actual decay of the root, or whether to the fact that each result came from a different plot of ground, or because of different care in extricating the roots from the soil, we have no information. It may be due to the fact that there was less development of root in one place than in another.

Question. Might it not be owing to an absorption of the root into the top?

Prof. Johnson. It may be. I had supposed that old roots would have the greater absolute weight. If these figures are correct, they are interpreted by your suggestion, which is supported by some observations that have been made regarding the mode of growth of the underground organs.

In the next column of figures we have the ratio of root to top. The root is taken as a fixed quantity, ten. In the case of rye we have in the first place, 10:17; then 10:45, 10:59, 10:136. In the case of clover, 10:16, 10:19, 10:23, and lastly 10:15, which may be an error of observation.

Here you have another capital fact brought out—the greater relative quantity of roots in the ripe clover plant. You have half as much roots as top, in the clover plant, whereas you have almost fourteen times as much top as roots in the ripe rye plant. These plants, then, are very different in the way in which they act upon the soil, and therefore in the way in which they leave the soil. When you reap rye close to the ground you take away one hundred and thirty-six out of one hundred and forty-six pounds, and thus leave very little in the soil. When you cut clover you may leave half as much in the ground as you take off. That is a point of great importance in considering their relative bearing upon the question of exhaustion, and shows that you may expect a very different result from leaving clover roots and clover stubble in the soil than from the roots and stubble of rye.

MR. LYMAN. If we cut the rye low we take very nearly the whole of the plant off from the land, and it requires five times as much put back to bring the rye field up to an equality with the clover field, as it stands cut, with the roots in the ground. Therefore we cannot look for a crop that would be equal to what clover would bring us unless we restore this ratio.

PROF. JOHNSON. You are right.

MR. LYMAN. What is the difference if we plow the two crops under.

PROF. JOHNSON. The total weight of your rye crop is 272; the total weight of clover is 246; so that in this case the clover has a somewhat less absolute mass of vegetable matter.

QUESTION. There are two or three other important questions. We want to know if the plants take from the soil a certain amount of manurial constituents or saline matter?

PROF. JOHNSON. They do, of course. That is one of the first principles of agriculture.

QUESTION. Do these roots left in the soil create any thing?

PROF. JOHNSON. Nothing whatever.

QUESTION. Then they take from the soil manures to grow them, the same as what you take off?

Prof. Johnson. Certainly. They take manures or equivalent nutritive matters.

Question. It took all these manurial matters to make this crop, and if you carry it off you carry off those manurial matters; whatever you leave restores what it took to make it, and no more?

Prof. Johnson. Yes.

Mr. Gould. Ought it not to be said that in its previous condition the manurial matter was in an insoluble condition, not adapted to the plant; whereas, what you leave is in a soluble condition, and assimilable?

Prof. Johnson. During the growth of a crop, plant-food in the soil does pass from an insoluble into a soluble form, and being taken up by the crop remains in that part of the crop left in the field in a state adapted for immediate use. The deep-rooted clover also, in this case, brings up, from an average depth of sixteen inches, matter which remains in part within the range of shorter-rooted grain crops.

SECOND LECTURE.

Prof. Johnson. I was speaking yesterday on the peculiarities of plants which enable them to act differently on the stores of nutriment which may be supplied to them in the soil. I spoke of the differences in the absolute quantity of roots which various plants put out into the soil, and also of the differences in the depths of roots; and gave some illustrations on those points. I propose to speak this morning of the different structure of the foliage of plants.

We know with absolute certainty that a large share of the feeding of the plant is done through the leaves. We cannot certainly tell how much goes on through the leaves and how much through the roots, in highly manured and very rich soil, but experiments have demonstrated that all the carbon of the plant (which is about fifty per cent of the weight of the dry plant) may come from the atmosphere; it is not necessary that any of it should come from the soil. The seeds of various agricultural plants—Indian corn, oats, barley, etc.—have yielded a larger increase under artificial circumstances, where the roots had no carbon whatever at their disposal, than is ever produced under field culture. It is a well-known fact of agricultural practice, that soils which are nearly destitute of vegetable matter, and therefore have no considerable source of carbon in them, will produce large crops. Some very sandy soils, containing but little carbon, may be made to produce heavy crops by irrigation. Crops are also raised on soils free from organic matter, or from sources of carbon, by the aid of fertilizers which themselves furnish nothing of that sort.

Carbon, then, which makes up half of the weight of the dry plant, is always chiefly supplied by the atmosphere and may be supplied by the atmosphere exclusively. It is not necessary that it should be in the soil. The nitrogen of the plant, which forms indeed a small proportion—two per cent. perhaps, as an average—of the dry plant, is still an important ingredient, for without it vegetation cannot exist.

Some crops have the power of gathering nitrogen without any difficulty; they not only supply themselves with it, but they even cause its accumulation in the soil. There are other crops which are dependent upon artificial supplies of nitrogen, unless the soil be naturally very rich in this element—crops which, if we undertake to raise them continuously on the same field, presently begin to show that they lack something, while if we apply nitrogenous compounds as fertilizers, the growth is ensured. We do not know in full detail how plants acquire a sufficient supply of nitrogen from the atmosphere, but we conclude, with great probability, from the results of practice, that different plants draw on the natural supplies of nitrogen in a different way.

Let us consider how the structure and habits of two typical crops, wheat and clover, stand in relation to their power of assimilating atmospheric nourishment. In respect of foliage we cannot certainly say that the wheat plant or the wheat crop when full grown exposes a less surface to the air than full grown clover, but we know that the leaves of wheat, as of all our cereals, maintain their green color and succulence during a much shorter time than is true of clover. In case of winter grain the period of leaf-activity usually begins in October and ends shortly after heading out, in June, some weeks before the crop is harvested. Clover, on the other hand, is not arrested in its growth by any crisis of seed-production, but, when cut for hay, sends up new shoots, unfolds new leaves, and shortly yields an aftermath, its growth going on uninterruptedly all the summer and late into autumn, until checked by heavy frosts.

That the actual leaf surface of the clover crop, taking its duration into account, is much greater than that of the wheat crop, I do not doubt, because although the total weight of the harvested crops is, on the average, not very unlike when clover is cut for hay,* the total amount of vegetable matter organized is much greater in case of clover than in that of wheat, as appears from the table on page 245, where clover roots are seen to constitute two-fifths (equal to six-fifteenths) of the entire plant, while the roots of rye, which doubtless do not differ much from those of wheat, are but one-fifteenth of the entire plant.

You see that the foliage and mode of life of these two classes of plants are very different for the purposes of gathering food from the atmosphere, and they must therefore be expected to leave the soil in very different condition, because their roots remain there, and the material of those roots is

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* Corresponding crops are, according to

	Winter Wheat. Lbs. per acre.	*Clover.* Lbs. per acre.
E. Wolf,	6,280	5,840
Lippe-Weisenfeld,	5,760	6,390
Rohde,	4,270 to 6,400	3,480 to 5,280

gathered very largely from the atmosphere; so that when we raise a grain crop we leave in the soil a small quantity of material taken from the air, but when we cultivate a deep-rooted plant which grows the season through, we leave a large amount of atmospheric matter in the soil.

Again, in ordinary culture some plants are permitted and required to reach a crisis of growth which others are not allowed to attain. This crisis is seed-production.

Our meadow grasses are of the same botanical order as the cereal grains; which means that all these plants are of the same great race and closely resemble each other in their most characteristic features. The noble wheat and the scoundrel quack are, in fact, brothers of the same family, both being of the genus Triticum. The latter is sometimes termed wheat-grass, as if in allusion to this brotherhood. There are two other grasses, vagabond members of the wheat family, living obscurely in this country. Barley and the oat have each two brothers of low degree—worthless grasses, living on salt or sandy shores, or on rocky hills, and unknown to the cultivator.

If wheat, instead of being allowed to ripen its seed, as is our universal practice, should be mown or fed off just before heading out, it would throw out new shoots and continue to grow the summer and autumn through, would come on the second year and deport itself as a perennial; would in fact, become grass in the usual sense of that word.* Wheat is probably not hardy enough to make a good substitute for Timothy, but it is sufficiently so to justify our statement.

The reason why wheat under our culture is an annual is that the process of seeding exhausts the plant, and as a consequence it dies out naturally. It is the universal opinion among farmers that the meadow grasses are weakened very much by being allowed to go to seed. I have myself observed that where Timothy seed was raised the crop of grass the next year was very small, although the soil was excellent. The plants had suffered severely from being allowed to go to seed, notwithstanding Timothy has a bulbous root, which should fortify it considerably against this strain, and a small seed, which renders the exhaustion less than is the case with our bread-grains. The production of seed is thus a critical thing for the life of the plant.

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*In the year 1858, a frost fell upon the wheat fields in the central portions of this State just as the wheat was in blossom, and such wheat fields were ruined so far as the production of grain was concerned. The farmers declared that "wheat in blossom was as tender of frost as the tomato." Some of the farmers mowed these wheat fields for fodder, and were greatly astonished to find that the wheat stubble again sprouted and made a vigorous second growth. Unfortunately it was plowed in the fall and not suffered to produce a wheat crop the succeeding year. K.

Let us consider again for a moment, the mode of growth of our cereal grains. Sown in the spring, the plant comes up and grows, slowly at first, but with increasing vigor, up to the time of "heading out"—a period of two months. Then the growth acquires its greatest intensity. It heads out, blossoms, and the seeds begin to form and ripen, and this whole process of seed-production requires but about a month when the weather is favorable for its completion.

In actual trials with the oat plant, it has been found by Bretschneider and Arendt that a large share of the growth of the over-ground part of the plant occurs at the time of heading and blossom. Thus the former observed that out of 6,886 lbs. of the dry acreage yield of the oat, 3,099 lbs., or three-sevenths of the crop, were produced from June 19th to July 8th, i. e., in nineteen days; the total period of growth being one hundred and six days. Arendt found that three-eighths of the total dry produce of the oat grew in twelve days, 18th to 30th of June, the period of heading and bloom, and during the twenty-two days between June 18th and July 10th, nearly three-fifths of the growth took place. [How Crops Grow, p. 205, *et seq.*]

Before the seed is ripe the lower leaves begin to turn yellow, and show that their activity is diminishing or has ceased altogether, and the ripening of the plant takes place to a great extent, by the removal of matters which have been previously stored up in the stem, leaves and roots, into the seed. You may cut any of the grains at the root when the kernel is in the milk, and the seed will still ripen, and although, if you cut it too early, the kernel will shrink, it will be perfect in its parts and serviceable as seed-grain.

It thus appears that the cereal plant grows from the soil and atmosphere until the seed arrives at a certain stage of development, then the activity of the roots and foliage decreases, the acquisition of food from external sources gradually diminishes, until it ceases altogether, the plant concentrates all its energies upon the seed, all its juices flow thither, and the roots, as well as the leaves and stem, are exhausted in the effort. The seed grows, not directly at the expense of the soil and atmosphere, as the plant has done, but at the expense of the plant itself. It is, indeed, true in all cases that the seed is formed from the plant itself; but there are plants which, while feeding the seed from themselves, are still active in gathering food from external sources; and other plants, like the cereals, which do not, at the same time that they are elaborating seed, gather food from outside sufficiently to maintain their individual life.

In contrast with the cereals, look again at the clover plant. This starts from a seed, grows vigorously, buds, blossoms, forms seed, and the seed ripens; but there is not that uniformity in the time of budding, flowering and ripening of clover that is noticed with wheat. In a field of wheat, if the catch has been good and every thing is as it should be, when one head is ripe all the heads in the field, practically, are ripe. Every stem heads out, blossoms and ripens about the same time. In the case of clover you have a much greater diversity, especially when the soil is rich and the plant grows thriftily. If the soil is poor, you will have a nearer approach to uniformity. When you are getting a large amount of foliage, you will find on the same plant ripe heads and buds. If you pick off the ripe heads the plant will still keep throwing out new buds. The process of flowering and ripening is a continuous one, and it does not affect the vigor of the plant to nearly the degree that happens to wheat. During all the period of the growth of the clover plant until the seeds are ripe, the roots are still active and the foliage still vigorous. The quantity of seed produced by the clover plant is much less, relatively to weight of the plant, than the quantity of seed produced by the wheat plant, and the energies of the clover plant are relatively less occupied in ripening the seed than is the case with wheat.

You would therefore expect these very different plants to have a very different function in the rotation of crops.

An annual plant again, one that is sown in the spring, or in the fall, perhaps, and is harvested within a year, other things being equal, will be different in its relation to the soil, from a biennial plant, which lives two years, or a perennial plant, which keeps along indefinitely. Now, our ordinary grains are annuals, as we cultivate them; the clover plant is a biennial more nearly than anything else. When it grows vigorously, it is usually spent in about the second year. We may not call it properly a biennial in a botanical sense, but in an agricultural sense it is a two-year old plant. We cannot depend, ordinarily, upon having much clover from the sowing of 1872, later than 1874, except as the result of self-seeding. Our natural grasses are perennial; they live, we do not definitely know how long. Their mode of propagation, besides from seed, is by root-suckers; the old root dies, but in the meantime it has propagated a numerous family, which succeeds it, and the race is kept up without the trouble of sowing any seed or giving any attention to the matter at all. These distinctions make an obvious difference in the relation of the three kinds of plants to the subject of rotation of crops.

We have thus considered the plant itself, its roots, foliage, and manner of growth; now let us look more closely at what remains in the soil when the crop is removed. This matter came up incidentally, and a little out of order, yesterday, as I referred to the tables on the board. When I raise a crop and harvest it, I leave, of course, the roots in the soil, I leave the stubble on the surface. If each crop were taken out of the soil completely, root, as well as branch, so that nothing of it were left in the field, the exhaustive effect of any crop upon the soil would be measured simply by what we took away. But we leave a great deal in the soil. Ever since farming has been practiced, the value of what is left on and in the soil has been to some extent, appreciated, but we have not known accurately the quantities or the relative proportion of those substances. We have known that clover leaves much more than wheat, but the precise relation we have not understood as we understand it now, and we do not understand it now as we ought to and as we shall understand it after further investigation. I referred yesterday to the table of Dr. Weiske, of Proskau, which gives the ingredients of the stubble and roots of various crops remaining on and in an acre of land after harvest. (See page 244). This is the first, or nearly the first, exact experiment of the kind that has ever been made, and these observations must be repeated here and there, on different soils, before we can get entirely trustworthy data, to enable us to make a satisfactory calculation. Still, these first results will serve a very good purpose.

In the case of rye, for instance, you have 3400 lbs. of dry vegetable matter remaining in the soil to the acre. Ordinary rye straw contains some fourteen per cent of moisture. The vegetable matter in the table is considered free from that variable amount of water which is always present in the plant, unless it has been dried at the temperature of 212°. In the case of barley, we have about half as much as in rye—1515 lbs.; in oats, 2200 lbs.; in wheat, 2240 lbs.; in red clover, 6580 lbs.; in buckwheat 1630 lbs., and so on. You see that in the amount of matter remaining in the soil, the clover crop far surpasses any other. If it were a fact that the organic vegetable matter of one crop remaining in the soil, supplies the food for the following crop, you see that what remains in the soil from a good clover crop would furnish the material for about three oat or wheat crops. It is not the fact, that the vegetable matter from one crop acts as such directly to support the succeeding crop; but it is a fact that some of the ingredients of the vegetable matter are of use to the succeeding crop, and in some places must be supplied, in order that the succeeding crop may grow. That is especially true of nitrogen. We have in the clover field a residue of 180 lbs. of nitrogen; in rye, we have 62 lbs.; in oats, 25 lbs.; in some other crops we have a larger quantity; you see how the figures run, (p. 244). This nitrogen came partly from the atmosphere by the foliage, and partly from the soil, taken up by the roots. The clover residues contain three times as much nitrogen as those of rye, and 7 to 8 times as much as those of wheat, barley, or oats. We have 246 lbs. of lime remaining in the residue of clover—three times as much as in that of any other crop. This, of course, came from the soil. All these shallow-rooted plants, when they succeed clover, find ready to their, hand, in the upper eight or ten inches of the soil, material brought up by the previous clover crop from twice that depth, or more. The clover not only furnishes to the succeeding crop these mineral matters that were in the upper portion of the soil, but it takes them up from a depth where they would not be directly accessible to other plants, and puts them where they are wanted. The clover plant leaves in the surface soil, as the table shows, a much larger quantity of all those materials than any other crop. The only apparent exception is that of soda, and soda is a substance which is not, as the best information we have upon the subject tends to show, essential to any cultivated plant. We have of magnesia, 46 lbs. in clover, against 14 in rye. Of potash, 77 lbs. in clover against 30 lbs. in rye. Of sulphuric acid, we have 24 lbs. in the case of clover, against 12 in the case of rye. Of phosphoric acid, which is, on the whole, the most precious mineral substance in the soil, because it is the most costly when we have to supply it by purchase to our fields, we have 71 lbs. in the case of clover, against 24 lbs. in the case of rye.

Now, the point comes in here again to which I referred yesterday; namely, the ratio of root to top and of foliage to seed. In the rye crop, when ripe, I have nearly 14-15ths of the vegetable matter above ground (and the same is probably true of all the grains), and when I get off my crop, I get off 14-15ths of the whole. (See table, page 245.) Fourteen-fifteenths of the vegetable matter is carried away in my grain and chaff and straw, if I cut close to the ground. In the observations whose results are given in this table, there was no stubble. If I leave stubble on the ground, I reduce the proportion of removed substances. When I take off the clover plant close to the ground, for every fifteen pounds I take off, I leave ten pounds in the soil; whereas, in the case of rye, for every fourteen pounds I take off, I leave only one in the soil. That is a great difference. When I cut the grain crop low, I take it nearly all away; but when I mow off my clover hay, I leave two-thirds as much as I take. The assertion which has been made, that the part of the clover crop remaining in the soil is as good as that which goes into the barn, finds its justification in these figures. They show with precision and in detail, what observing farmers have long vaguely known.

The reason of the truth of the old saying, that if you can start clover, you can grow anything, is thus apparent; and we know further, from observation, that the habits of the clover plant are such that we can often start on a course of improving the soil with that plant when we could not with what are commonly called our more valuable cereal grains. Some years ago, I was in East Windsor, in this State, and I was shown two fields, separated by a fence, one of which you would call perfectly barren and useless; on the other was a growth of red clover a foot high, which I was told by Mr. S. W. Bartlett of that place, had been brought up within twelve months by the application of a bushel or two of plaster to the acre and turning in some sheep. I believe there was no seed sown upon the field; the plaster alone brought the clover in. The plants were there in an undeveloped state, and I suppose the plaster, by furnishing sulphuric acid and lime, both of which are large ingredients in clover, supplied the two things or the one thing, it may have been, which was necessary in order to give the clover a chance to live. On the other side of the fence, one or both of these substances was probably not present in sufficient quantity to develop the starveling clover plants and to start their deep roots into the soil; but with that start, there is no reason why that land could not be made agriculturally profitable. It could never be converted into such soil as the Genesee region or a western prairie, because the original constitution or strength was not there; but it was a soil which might, by judicious management, be improved, and brought up to a reasonable degree of fertility. It would be hopeless to undertake to reclaim any such field as that by the use of wheat grown for seed; it might be done by rye cut green, but it would be a much slower process than by clover. The fields in that neighborhood had been cropped with rye beyond the memory of the oldest inhabitant. The plan had been to take off a crop of rye once in three years, getting about nine bushels to the acre, leaving the soil to itself the other two years. Three years of weathering, and atmospheric action on that soil, put it into a condition to make a rye crop of nine bushels to the acre. If that rye were turned under, instead of being cut off, so as to make the soil more retentive of moisture, it could be brought up; but the clover plant is adapted to do that thing much more rapidly than the rye plant.

We now come to an important question, viz., the possibility of continuing the same crop on a field indefinitely. Should you ask me if that can be done, I could answer both "Yes" and "No," and be equally right in each reply. There are quite a number of agricultural questions that can be answered in just that way. Instances can be brought up in which almost any crop has been grown continuously, without interruption, or with no more interruption than the nature of the plant requires, for a term of years—in many cases for a long period of time. I mentioned yesterday the experience of Mr. Lawes, who has grown wheat twenty-seven years in succession on the same soil, and, without any manure, has got an average of 16 bushels to the acre; while with manure he has averaged 36 bushels to the acre. We know that tobacco can be raised year after year on the same soil, with the help of manure and thorough tillage. The same is true of onions, buckwheat, rye, in fact, I do not know of any crop that may not be grown in that way. And yet, "circumstances alter cases." Clover will not grow on this or that farm, or on this or that field, with such and such culture, to advantage, unless an interval is allowed between the crops. In some sections you cannot grow rye without interruption, and anybody can find cases in which none of our crops will succeed, for several years in succession, or even succeed at all. These differences depend chiefly upon the soil, not upon the plant, and it is dangerous to make any sweeping or absolutely general statement where so variable a thing as the soil is concerned.

Clover is a plant which has often given farmers a great deal of trouble to grow year after year, or to cultivate in quick succession. It is generally admitted as a rule of practice that there is, ordinarily, no profit in attempting to grow wheat two years, or, at the furtherest, three years in succession on the same soil. It is admitted to be a good plan generally not to grow any crop more than two or three years in succession. Even our natural grasses are included in this rule, although in some particular localities they do well indefinitely. We have indeed natural meadows and pastures which are as old as the memory of man and just as good now, for ought that can be seen, as they ever were. But even in the case of natural pastures we know that "circumstances alter cases." Each farm, perhaps, may have some low-lying piece of moist land occasionally flooded by a river, where grass can be cut year after year, year after year. Then we have uplands which must be broken up once in a while; they get "hide-bound," and the grass runs out. These facts are familiar to you all, and illustrate the broad statement that there are some soils where the same crops can be cultivated for a succession of years and other soils on which rotation is quite indispensable. There are soils where clover has been grown once in three years for a very long period. I have in mind a valley in the Austrian Tyrol—the valley of Saint Martin—where this has been done. No one living can remember the time when this practice was not followed on certain parts of that valley. They have a marl which is regularly put upon the land, and by its use the clover crop continues undiminished from generation to generation. Its growth there is also very luxuriant, the ordinary clover stems being five or six feet in height. This is a very remarkable case of natural clover ground kept unexhausted by a native fertilizer. But the land of Mr. Lawes, adjoining the fields where he raised wheat without interruption for twenty-seven years, would not carry clover except at quite long intervals. Mr. Lawes made a series of experiments on this land, beginning in 1848, and going on until 1860, in which he applied stable dung, coleseed cake, super-phosphate of lime, sulphates of potash, soda, and magnesia, sulphate and muriate of ammonia, soot, and fresh burned lime, singly and in various combinations. The following is a sketch of the history of the crops obtained from four acres, divided into eighteen plats, during twelve years: 1848; sown to clover and barley, having been heavily manured the previous season and borne a large crop of Swedish turnips. 1849; manured with various applications. Three cuttings yielded at rate of from three and three-fourths to nearly five tons per acre. Seeded in fall to wheat. 1850;

in spring clover-seed was sown on the young wheat. The wheat yield was at rate of twenty-seven to thirty-six bushels per acre. After harvest, the clover catch not being good, the land was plowed. 1851; after manuring again, clover-seed was drilled in, April 28; came up well and was cut in September. Best yield was at rate of one and one-third ton of hay. 1852; clover looked well in winter, but in March symptoms of failure became apparent in many of the plats; later it died out in patches, more or less, in all the plats, still on the whole a good plant remained, and two cuttings gave hay on best plats at rate of two and one-fourth to three tons per acre. 1853; plants stood fairly through the winter but nearly all died off in spring. Land was then plowed and fresh clover-seed drilled in; plants came up weak. There was no crop worth cutting in autumn and during winter nearly the whole died off. 1854; field was plowed and left fallow till September. After heavy manuring (twenty tons yard manure per acre on some portions, and 5,000 pounds quick-lime on others) clover-seed was drilled in October 10. Plants came up, but died off during winter. 1855; clover-seed drilled in April 14. Best crop was at rate of one and one-quarter ton of hay per acre. Plants died in winter. 1856 and 1857 land was left fallow. 1858; sown to barley without further manure; crop fifty-eight to sixty-five bushels per acre. 1859; without manuring, sowed to clover. Crop cut in September was one to one and one-half ton hay per acre. 1860; plant looked well through winter, but as spring advanced died off rapidly, and in June the few remaining plants had a stunted and unhealthy appearance.

Thus, after seven sowings and the liberal use of every fertilizing element, Mr. Lawes was compelled to see a complete failure of the attempt to keep his land in clover. He relates that in the rotations customarily practised in his neighborhood, a good yield of clover can be relied upon once in six or eight years.

Dr. Riggs. The land was what they call "clover-sick."

Prof. Johnson. "Clover-sick," and finally clover-dead!

Mr. Lawes made another interesting trial on a piece of originally similar ground, which had, however, been used as a kitchen-garden probably for two or three centuries. It was sown to clover early in 1854, and from this one sowing the plant grew well, without further manure, for six years and yielded in that time fourteen cuttings, at the rate of twenty-six tons of hay per acre for the six years, or four and one-third tons yearly.

In discussing the causes of clover sickness, Mr. Lawes suggested that the assumption that clover requires a portion of food to be supplied by the soil in the form of certain organic compounds—vegetable matters or humus, such as are contained in garden earth and come from the yard manure, would perhaps explain why the crop failed on ordinary soil, but should succeed in a garden which had been heavily manured perhaps for centuries. Mr. Lawes did not assert that this was the reason, only that it *might* be.

But I thing we have facts enough to justify us in concluding that that is *not* the reason. When a student in Germany, I saw an experiment by Dr. Wolff of the Academy at Hohenheim, which he was in the habit of making for the benefit of his classes. He took a quantity of rather poor soil, and calcined it in a clay muffle—a kind of oven which is heated by fire burning all around it, so that its sides are brought to a bright redness. This operation completely burned out all the organic matter of whatever kind that was originally in the soil. To that soil he added the various components of the ashes of plants which are given in the table, page 224, viz.: lime, magnesia, potash, soda, phosphoric acid, etc., in proper proportions, together with a certain quantity of saltpetre—nitrate of potash—and in that soil he raised the most beautiful clover. You can grow anything to perfection in that way. You do not need a particle of organic matter in the soil for the growth of any plant. Many plants have been grown in simple water in which the mineral elements of the plant, including nitrates, were dissolved or suspended.

The suggestion that the result, in the case to which Mr. Lawes refers, was due to the absence of vegetable matter, must therefore be regarded as destitute of foundation. I believe that if he had spaded his land as deep as the roots of clover go, and had fertilized it well to the same depth, he would have cured the clover-sickness effectually.

The weight of evidence goes to show that this "disease" is owing to the lack of nutritive material in the lower strata of soil, where the long clover-roots go, and where they must find nutriment. Those soils which are naturally adapted to clover are those in which an equivalent to deep manuring is created by the disintegration of the soil itself to a considerable depth.*

Mr. Lyman. We have instances in this country where clover has grown for thirty years in deep soil.

Mr. Gould. The soil of the Genesee wheat lands, where their regular practice has been, for seventy or eighty years, to alternate clover and wheat,—wheat is their staple crop, and always has been, and they always prepare for it by a crop of clover,—is what you would call a rich loam, mixed to a considerable depth with fragments of a slaty rock. This slaty rock decomposes so rapidly as to keep the soil constantly rich, and rich to a considerable depth. It does not decompose on the surface rapidly enough so that they can get a wheat crop every year, but if they put on clover and let its roots go down where there are materials which the roots of the wheat plant cannot reach, and bring those up to the surface, then their wheat crop runs right along, and if rust or insects do not interfere with it, they get a large yield every time they try it. They have two years of clover and one of wheat.

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*In a letter dated Rothamstead, November 7, 1872, Mr. Lawes writes me as follows: "I beg your acceptance of a summary of our clover experiments, by which you will see that we have altogether failed to grow clover by means of manures placed at different depths (as far as three feet in some cases) through the soil. I think we have almost exhausted all ordinary modes of field experiment, and I am disposed to think that the solution of this problem will not be effected until more refined investigations are commenced." S. W. JOHNSON.

PROF. JOHNSON. Do they cut the clover entirely off?

MR. GOULD. They do, one year. They generally have a pretty good crop before they plow it in. They plow it in, usually, about the first of August.

DR. RIGGS. They take off the first crop, and plow in the second.

PROF. JOHNSON. There are some further facts in regard to clover which are very interesting. Dr. Voelcker, who has been Chemist to the Royal Agricultural Society of England for the last twelve years, when he was formerly in the Royal Agricultural College at Cirencester, found that some of the farmers in the vicinity not only thought that clover was an excellent preparation for wheat, but asserted that the wheat did better when, instead of plowing in the second crop, they took it off. The doctor we may suppose was rather incredulous; but he found other farmers who said, "Our wheat does best when we let the clover ripen, and save the seed and put the wheat in after that." These opinions were put to him in such a way that he could but candidly say, "It would be folly to deny such statements on my knowledge of what is probable; I will look into the matter, and satisfy myself by my own trials. I am living here on the ground, and I can make the experiments, and if it be true, that taking off two crops of clover leaves the soil in better condition for wheat than when one crop is taken off, if I examine the soil when one crop has been taken off and when two crops have been taken off, I ought to find more available nitrogen and more available phosphoric acid in a given quantity of soil in the latter case than in the first case; and if it be true, that where the plant has been allowed to go to seed, the preparation for wheat is still better than in the other two cases, I ought to find still more of those materials." He made the investigation, and actually found that the quantity of those nutritive materials left in the surface soil after the clover seed had been taken off was greater than when two crops of clover hay had been cut, and greater when two hay crops had been removed than when only one had been taken off. That is due to the fact, which I have already insisted upon, that the clover plant, after producing its seed, is still able, when the character of the soil is adapted to it, to continue its growth and bring up to the surface-soil those materials which the wheat crop cannot reach. We cannot, from cases of this sort deduce rules of universal application, and this English experience may not apply to the Genesee valley or to the lands of this vicinity, because of differences of soil, but these results of Dr. Voelcker are of very great importance. They enable us to make the experience of those Cotswold farmers of general value, by showing us the reason of their result. They furnish us a grand contribution to our knowledge of the capacities of the clover plant. If the farmers of Genesee do not find the rule to hold good with them, we shall find, by study, the reason for it.

QUESTION. It is often asked, What is to be done with our side-hill pastures in New England, that are too rough and hard or too steep to plow and get manure on? I have a pasture of this kind. It is naturally moist land, pretty stony, and it has begun to be covered with moss. Forty years ago, one acre of it produced more feed than two do now. What shall I do with that land? It is considerably steep, and it would be very unprofitable to undertake to plow, manure, and cultivate it. I have been thinking of putting on a heavy harrow, well sharpened, with a strong team, in the month of March, when the ground is thawed say three or four inches deep, and harrow it severely, and then sowing clover. Can we not in that way resuscitate these old pastures, so that they will produce something again? If I can get some information on that point, it will be valuable to me, and I think I have neighbors who would receive benefit from it. We have immense quantities here in Windham county of moist side-hill land, too rough to plow and cultivate. What is to become of these pastures? Are they to become a loss to us?

Mr. Low. Travellers in the northern portion of this county will find a great many acres of that kind of land which are producing most luxuriant grass, the result of the application of plaster and ashes. You do not need clover seed if you put on ashes and plaster.

Prof. Johnson. There is one question to which Mr. Gold referred in a letter to me written previous to the one which I read yesterday, and that is, the waste of manure, which seems to belong to the production of some crops and not to others. Any man who for twenty-five years will cultivate a number of plots of land with different crops and different fertilizers, will get hold of a great many facts and find a great many questions coming up which it would be exceedingly interesting to discuss. This is what Mr. Lawes has done. He has shown that on his land, in order to get a large crop of wheat, he must use a great deal of one kind of manure. I mentioned, yesterday, that he got 16 bushels of wheat to the acre, for twenty-seven years, in unbroken succession, on land to which he applied no manure whatever; that by the use of 14 tons of stable manure per acre, applied annually, he was able to get 36 bushels of wheat. By using all the elements of our fertilizers, with the single exception of nitrogen, applying phosphates, sulphates, and carbonates of lime, magnesia, potash, and soda, all the fertilizing matters which are found in ashes, in guano, or in stable dung, nitrogen compounds excepted, he raised the crop to barely 25 bushels; but when, to one good dose of these materials, he added annually 400 lbs. of salts of ammonia, or nitrate of soda, the yield went up to 36 bushels and held at that point for years. This difference between 25 and 36 was unquestionably due to the nitrogen of the nitrate of soda or salts of ammonia. If the facts admit of any other inference, I do not understand the logic which can make it.

Let us compare the quantities of nitrogen in those two applications. In the salts of ammonia, there were about 80 lbs. of nitrogen; in the barn-yard manure, Mr. Lawes says 200 lbs.;

but there are usually nearer 300 lbs. of nitrogen in strong stable manure. It would thus appear that there must be a great loss of nitrogen, and the wheat crop has got the repute, among some writers, of wasting a great deal of nitrogen in its growth.

On another plot of land, where Mr. Lawes raised barley, he applied 200 lbs. of ammonia-salts, which contained 40 lbs. of nitrogen, and raised 40 bushels to the acre. When he doubled his dose, and put on 80 lbs. of nitrogen, his grain was so heavy that it lodged and failed to ripen, and the crop was spoiled. Without the addition of any fertilizer, the soil gave him considerably less than half that amount.

I will mention some other experiments which may give us light on this subject, made by Dr. Hellriegel, who has been studying agricultural problems for some twenty years, having been all this time employed in one of the Experiment Stations kept up in Germany, partly by government and partly by associations of individuals, for the purpose of making agricultural investigations, by the help of chemistry and physiology, and whatever aids can be brought to bear on these questions. Dr. Hellriegel proposed to himself to ascertain what quantities of the different materials which plants require for their growth must be furnished to them in order to get a crop. We have for some years known that phosphates and sulphates of potash, lime and magnesia, and nitrogen must be given, but we need to know how much of each of these various substances is necessary. In order to arrive at accurate results, Dr. Hellriegel had to experiment under artificial conditions. So he took for soil a perfectly pure sand, or one as nearly free from everything that would furnish plant-food as possible. In a large series of experiments, he mixed the soil with a sufficient quantity of all the materials necessary for the support of a crop, with, in each case, one single and different exception. These excepted substances he added in graduated quantities, putting one quantity in one box of soil and a larger in another, and so on through a sub-series of eight or nine boxes, in order to ascertain by the growth of the plant, in which case he had hit the best proportion of these ingredients. His trials have been extended to the whole list of the elements of the plant. In regard to water, for example, he found that the growth was greatly influenced by the quantity of this substance with which the crop was supplied. There was a certain quantity of water in the soil necessary to a maximum crop, other things being equal. In the sandy soil which he experimented with, the largest yield of rye, wheat, or oats was obtained when the soil held steadily ten or fifteen per cent of its weight of water. On increasing this proportion, the straw in some cases was heavier, but the grain was reduced in quantity. Thus the very fact that the amount of rain fall is unequal in absolute quantity, and unequal in distribution from year to year, is of itself a reason why you get different crops, everything else remaining perfectly the same. That is a matter always to be taken into consideration in judging of the value or effects of a fertilizer. But it is the effect of nitrogen I am coming at. Dr. Hellriegel experimented with various quantities of nitrogen (in the form of nitrates), applied also to cereals. The plants grew in the artificial soil, consisting of pure sand, with an admixture of ash ingredients in such proportions as previous trials had demonstrated to be appropriate. All the conditions of the experiments were made as nearly alike as possible, except as regards the amount of nitrogen, which, in a series of eight trials, ranged from nothing to eighty-four parts in a million parts of soil. The following table gives the results: *

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* See also "How Crops Feed," p. 288.

Effect of various Proportions of Assimilable Nitrogen in the Soil.

Nitrogen in 1,000,000 lbs. of Soil.	Yield of Grain in Lbs.			Nitrogen in 1,000,000 lbs. of Soil.	Yield of Grain in Lbs.		
	Wheat.	Rye.	Oats.		Wheat.	Rye.	Oats.
0..........	0.0	0.2	0.3	28..........	3.7	4.2	6.2
7..........	0.5	0.8	0.9	42..........	6.1	5.1	7.0
14..........	1.7	1.9	2.6	56..........	7.2	7.1	9.0
21..........	2.7	2.6	3.8	84..........	9.2	8.7	9.3

The maximum crops of wheat and rye were obtained with eighty-four parts of nitrogen to one million parts of this soil, but the maximum oat crop was got with fifty-six parts of nitrogen, at least; the gain between fifty-six and eighty-four parts of nitrogen, in the case of oats, was a mere trifle. Dr. Hellriegel made some other observations, which he has not reported in detail, which led him to conclude that he might have got his best crop of wheat with seventy parts of nitrogen, his best crop of rye with sixty-three parts, and his best crop of oats with fifty-six parts, to a million parts of soil. This soil which he used was not a large absorbent or fixer of the substances furnished to the plant. The nitrogen which he used was in the form of nitrates, which are never absorbed by soils, so far as we know. The matters with which he enriched the sand, therefore, were soluble and entirely available to the plant. The latter had only to stretch out its roots to obtain its food, and the quantity of soil was small, so that the roots had not far to travel, and could so completely occupy the soil as to come in contact with all the nourishment it contained.

Question. Does nitrogen form a part of the plant?

Prof. Johnson. Yes; an important part, always.

Question. How large a part?

Prof. Johnson. In the entire plant, when dry, from one-half to two per cent. In the different parts of plants it varies greatly. You have fifteen per cent. of nitrogen, for example, in the gluten of wheat; one and one-half to two per cent in the wheat grain; you have no nitrogen whatever in pure cotton fiber; there is no nitrogen in the sugar or in the starch of the plant.

QUESTION. Does it exist in the wood in the form of nitrate?

PROF. JOHNSON. No; but in the form of what is called albuminoids; something which is similar to the albumen or white of the eggs of animals.*

MR. S. L. GOODALE, of Saco, Maine. What is the comparative value of a given amount of nitrogen, in ammonia salts and in animal substances, such as blood, flesh, dung?

PROF. JOHNSON. It is very difficult to say; but these experiments of Mr. Lawes show that in order to get thirty-six bushels of wheat to the acre, he used two hundred pounds of nitrogen, in the form of stable manure, whereas eighty pounds of nitrogen used in the shape of salts of ammonia, gave the same crop. The reason of that is that the nitrogen of the salts of ammonia is in a condition to be made immediately available to the plant, whereas the nitrogen in animal manure exists in a form or in forms such that much of it cannot be taken up by the plant at once, if at all. It must undergo an alteration to become of use, and much of it, instead of passing into an available condition, doubtless becomes permanently inert.

MR. S. L. GOODALE, of Saco, Maine. What are the circumstances under which the nitrogen of manure is converted into into ammonia, which is retained in the soil, and what the circumstances in which it is converted into nitrates, which may pass out of the soil?

PROF. JOHNSON. So far as can be judged from our imperfect knowledge, a rapid decay of nitrogenous matter which goes on with comparative exclusion of air, generates ammonia; on the other hand, where there is a large access of air, there we have nitrates formed. But we do not know minutely the conditions under which nitrates are produced. Another fact to be noticed is this: that in the decay of animal matters with access of air, there is invariably a quantity, and often a large quantity, of nitrogen liberated in the state of free, gaseous nitrogen, such as exists in the air about us, and which does not assume the form either of ammonia or nitrates, and thus becomes lost as a fertilizer.

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* See "How Crops Grow," pages 94 to 109.

Mr. Gould. Before the current of questions drifts away from the main subject of the lecture, I am desirous of asking the Professor a question as matter of explanation. He has stated a distinction among plants—plants which exhaust the nitrogen and plants which accumulate nitrogen, in the soil. This is a subject of immense practical importance, and I think it will play a much greater part in questions of practical farming, than it ever has done in the past. The statement which he made would justify the inference, although he did not state it himself, that plants accumulate nitrogen in the soil in proportion to the surface of their foliage extended to the air, and to the length of time during which that foliage is in actual growth. The inference would be that there was a proportion between the amount of accumulation and the length of time. I desire to know whether the Professor wishes to be understood in that way?

Prof. Johnson. I would not assert that to be the fact, absolutely or unqualifiedly, but the indications very strongly favor that general conclusion.

Mr. Gould. That is my own personal impression. I wished to know whether the Professor so understood it.

Prof. Johnson. I was about to say how much nitrogen was needed in the soil.

A wheat crop of thirty-three bushels, with straw and chaff, contains fifty-six pounds of nitrogen. If we allow for stubble and roots one-fifth this quantity, we have for the total nitrogen required in the vegetation of an acre of wheat, say sixty-eight pounds.* Hellbriegel found, by actual trial, seventy pounds of nitrogen to be sufficient to produce his maximum wheat crop.

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* On examination of wheat roots collected by Schubart June 8th, 1855, Stockhardt found that the roots composed a little more than one-fifth of the entire plant, or

Mr. Lawes' soil furnished enough nitrogen to yield seventeen bushels of wheat. Addition of forty-one pounds of nitrogen, in form of ammonia salts, gave twenty-seven bushels, or an increase of ten bushels. Eighty-two pounds of nitrogen applied in the same form gave thirty-seven bushels, or twenty bushels increase.

The reason why Mr. Lawes was obliged to add eighty-two pounds of nitrogen to double the wheat crop, lies in the following considerations:

When ammonia is applied as manure, a portion of it is fixed in a comparatively insoluble condition in a clayey or loamy soil, and a share of this fixed ammonia it is doubtless very difficult for the plant to acquire. Again, nitrification, or conversion of ammonia into nitrates, goes on, and the nitrates are freely soluble and wash out of the soil. Then we know that the roots of the plant cannot come into contact with the whole of the soil, so that we should not expect that all the available nitrogen there would be taken up. The figures show that from seventy to eighty pounds is sufficient, provided it is in a form and in a position in which the plant can appropriate it. In stable manure we appear to waste a considerable quantity simply because it is not present in a form in which the plant can use it.

Now, stable manure, when it is put into the soil, may be compared with clover roots or any other vegetable matter put into the soil. Stable manure consists very largely of vegetable matter which has passed through animals, and of more or less litter which we mix with it. There is a small portion of the

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twenty-two per cent, and the nitrogen of the roots was a little less than one-fifth that of the entire plant, or eighteen per cent.

Heiden found the nitrogen of the roots of ripe rye but one-tenth that of the entire nitrogen. Stockhardt's examination was made on the *unripe* wheat. By ripening, the proportion would doubtless have been reduced. Heiden found, in fact, that the ratio of root to top in blossoming rye was about one to six, but in ripening was reduced to one to thirteen and one-half.

If, then, the roots alone contain one-tenth of the entire nitrogen, the roots and stubble may be fairly reckoned to contain one-fifth of the entire nitrogen.

Weiske, indeed, gives twenty-two pounds of nitrogen per acre for the ***roots and stubble*** of wheat, but we are not informed how high the stubble was cut.

nitrogen of the manure actually formed into these ammonia salts which Mr. Lawes applied, but most of the nitrogen, in order to to be used by the plant, must be transformed, must pass into some other state than that in which it exists in the manure itself; must probably either be converted into ammonia or nitrates.

Mr. Lyman. Suppose the case that I wish to use all the liquids of my stock, and absorb it all, and do not pay so much attention to the coarser manure. What, in your judgment, is the relative value of the one placed by the side of the other? This question is being agitated extensively.

Prof. Johnson. That depends somewhat upon the food which the animals have. If they are kept upon low rations the liquids would be the best. But if they are supplied with rich food, grain, meal or oil-cake, that indeed increases the value of the liquids, but increases more, relatively, the value of the solids, because you cannot get into the circulation of the animal beyond a certain amount of nutritive matter; but you can run through the intestinal canal much more material which is only partially digested, and so the value of the solid manures, as compared with the liquids, is increased by increasing the richness of the food.

When oxen or other herbivorous animals are kept on rations which just maintain them without much gain or loss of live weight, the daily urine usually contains rather more nitrogen than the dung. Sometimes the nitrogen of the dung exceeds that of the urine, but while all the nitrogen of the urine is adapted for immediate use as plant food, much of that in the dung is comparatively inert. The urine contains also more alkalies than the dung, but the dung usually contains all the phosphoric acid and most of the lime.

Measured by assimilable nitrogen or by alkalies, the liquids are much the best; measured by phosphates, the dung is most valuable. Practically, however, we cannot make a sharp separation. The solids nearly always absorb a good portion of the liquids.

I think I have now gone over about the ground that I contemplated. At least, we have approached pretty near the hour for dinner. With regard to the question about the improvement of pastures, there are a variety of ways in which the land can be saved from being useless. One of the most practical methods is to put on a top-dressing of some sort. The fact that moss grows there indicates that the soil is getting a little too moist, and it is a question whether plants will do well unless that moist condition of the soil is somewhat broken up. If those fields admitted of under-drainage, and it did not cost too much, that would be an effectual remedy against moss; you would never see that again. My excellent friend, Mr. Blakeslee, whispers to me, "Put on a flock of sheep!" and that is also an excellent prescription.

Mr. ——. We can't do it; the dogs kill them.

Prof. Johnson. The treatment which the gentleman suggests who asked the question, has nothing against it theoretically, and the fact that it has succeeded elsewhere shows it must be a good plan. There is no reason why such land should not grow into great value. If clover could be brought in it would probably raise the land in a couple of years to the productiveness that it had forty years ago, by simply bringing up the materials which the roots of other plants cannot get at. Probably any application containing lime or sulphate of lime, leached ashes, oyster shell lime, or any thing of that sort, would be beneficial. These things always favor the growth of clover.

Mr. Low. I have found the results of the application of commercial fertilizers so variable, under different circumstances, that I would like to have the Professor give us some information on the question whether, if we should incorporate with any litter or straw we have about our farm yards some chemicals that would act upon the soil something like barn-yard manure that would not be better than the chemicals alone.

Prof. Johnson. I do not know of any chemicals, except, perhaps, plaster, that can be advantageously mixed with the yard litter.

AGRICULTURAL COLLEGE OF MICHIGAN AND ITS INFLUENCE.

BY GEORGE GEDDES.

From the New York Tribune.

A feeling is becoming quite prevalent among farmers, and perhaps other classes of men, that the objects proposed by the action of the national Legislature in granting large quantities of the public lands to promote and make available such a system of education as should be especially adapted to the wants of persons engaged in producing the food of the people has been nearly lost sight of, and that most of the endowments have been perverted, and in many cases used to strengthen the funds of denominational institutions engaged in educating young men for the so-called learned professions, and principally for the pulpit. This impression of the public mind has become so general that the time has certainly come to investigate the facts, and to ascertain whether there really is an Agricultural College worthy of the name.

Michigan long since established in the woods, near the political capital of the State, an institution intended especially for the education of such young men as proposed to employ themselves during their lives in some other way than the practice of law or medicine, or in the instruction of the people from the pulpit. Something over 600 acres of land, a heavy forest then covering most of it, became its property,—and it was named an Agricultural College,—and from time to time was given, in small sums, assistance from the State. The first thing to be done was to create a farm and construct suitable buildings for the use of the faculty and students, and this must necessarily be the work of years. A history of the trials and labors through which this pioneer institution has passed to bring it to its present condition, would be interesting in the proper place, but forms no part of my present purpose, which is to give, as far as practicable, a statement of its present condition, referring to the past only so far as is necessary to explain why so much time has been consumed getting into fair working condition.

The grant made by Congress to all the States gave the State of Michigan 240,000 acres of land. This land was by the State given to this college, and by the catalogue of 1872 it appears that 47,232 69-100 acres had been sold, from which a fund has been created of $154,178 07, the interest of which is applicable to the support of the college, and it is expected that in three or four years the income derived from the sale of lands will make the college self-sustaining. So it appears that thus far the sales of land average very exactly $3 26 per acre, and if that rate can be kept up will finally give an endowment of nearly $800,000, the interest of which will be available to devote to the objects aimed at by the law making the grant. The farm —containing 676 acres, of which about 300 are under cultivation—has an undulated surface drained by a small river, a branch of the Cedar, which is a tributary of the Grand that runs into Lake Michigan at Grand Haven. The soil has all varieties of loam, from sandy to clayey, and beds of muck along the river and at other places; gentle slopes to valleys running in different directions give ample means of drainage. The original forest was principally oak, and many of its trees have been left about the buildings and in the lawns, and on these trees are labels giving their scientific names, to be read by every passer-by. The buildings are grouped on the gentle eminences that the undulating surface give, and the whole being three miles or more from the city of Lansing, and away from all accommodation for teachers or pupils, houses for the professors, as well as dormitories and other buildings for the use of the students, have been constructed. The necessary college buildings, proper for library, museum, recitation rooms, chapel, etc., have been provided, and in addition thereto the necessary barns, stables, etc., to conduct the farm, and enough has been done in the way of clearing land, and constructing buildings to justify the assertion that the college is now just fairly started in its great work, which has been officially stated to be:

First. "To impart a knowledge of science and its application to the arts of life;"

Second, "To afford to its students the benefits of daily manual labor;"

Third, "To prosecute experiments for the promotion of agriculture and horticulture;"

Fourth, "To afford instruction in such courses of study as the organic law of the college, as well as the act of Congress donating lands for Agricultural Colleges, contemplate, especially in military science, and in the application of science to the various arts of life, such as surveying, leveling, laying out of grounds, mechanics as applied to implements, stock breeding, agricultural chemistry, horticulture, etc."

Such are the avowed objects of this institution. A personal visit, it was thought, would be the best means that could be adopted to form an opinion upon the important inquiry—How far, and to what extent are these ends secured? On Monday, the 23d day of June, at about 11 o'clock A. M., I passed through the gate-way leading to the College grounds, the gates being opened and closed by the action of the carriage wheels, and passing through a well-conditioned lawn, over a good carriage road winding among the trees that had been reserved from the native forest, we drove to the building especially devoted to teaching chemistry, where I found Prof. Kedzie with his class before him, engaged in a recitation, which was interrupted only long enough by my appearance to glance at my letter of introduction, and then continued in my hearing. Enough remained to show me that the class had to give the closest attention. The exercises over, soon we were invited to dinner with the students. The dinner was plain, but of good food, well cooked, and the large room having the short tables now in such general use at hotels, was well filled with young men and a few ladies, and everything appeared to be conducted with order and proper decorum. The students are required to board at this hall, unless special permission is given to board elsewhere, and the board is furnished them at cost, and the last season was $3 per week. At the opening of each term every student pays to the Secretary $20, as an advance on board, which is allowed in the settlement of accounts at the end of the term; and settlements for board and washing are made quarterly, the washing being done for 40 cents per dozen. In addition to the advance payment of $20 on account of board, a student, on entering college, is required to pay a matriculation fee of $5, and every term $3.25 for incidentals; $1 for room rent; in all, $29.25, at the commencement of the first term. Students from other States pay per term $10, which is, for the year, $20.

In reply to the question, Can a student earn enough here, and by teaching during the long vacation which is in winter, to carry him through the college course? I was told that if he came with means to support him one year he could earn the rest. After the mid-day recess I saw the students at work in the garden, and in excavating for and in laying a large sewer through the grounds in front of the main buildings.

This sewer was to provide for the waters of an extensive tract of land outside the bounds of the college grounds, and was made of 18-inch tile, and covered. Frequent showers had caused a suspension of the work in the hay fields, and made that in the ditch unpleasant, but the students gave no signs of not going on for that reason. They appeared willing at their work, and as no exceptions are made, the usual causes of discontent appeared to have been avoided. Even the representative from Japan, sent here by his Government, and who will perhaps be Minister of Agriculture of that nation, must do his three hours' work every working day with the rest. The whole number of students, as appears by the last catalogue, was 131, four of them being ladies. The general appearance and bearing of these young men attracted my attention, and I was favorably impressed with their show of health and gentlemanly conduct. I learned that they were mostly the sons of farmers, and their ages would average nearly or quite twenty years, and that the privilege of working on Saturday was so eagerly seized upon, that nearly $2,000 was paid last year for work performed on that day. This is significant, as showing that the students desire work as the means of paying their way, and that the institution has been quite successful, viewed as a mere manual labor school.

Seeing the practical working of this body of young men in the field I became solicitous to learn clearly as to the course of study, to determine whether the managers of the College were looking forward to uses that their pupils were to be put to in future life; whether they were educating them to fill the high places in society, or merely in the arts involved in what is called "getting a living." Looking over the course of study I found logic and philosophy, chemistry in its various branches, meteorology, botany, horticulture, animal physiology, zoology, entomology, geology, mathematics, physics, civil engineering, language, including French and literature, embraced among other things in the course of study, and felt that the faculty were justified in saying:

"It is believed that students who complete the course will be qualified to follow agricultural pursuits with intelligence and success, or should some other profession seem more congenial, they will have the discipline and scientific acquirements that will enable them to pursue with profit the studies preparatory to entering it."

I asked the question: "What becomes of your graduates?" I was told that of the 73 graduates two died in the army before going into business; 31 are farmers; 16 have been or are now connected with Agricultural Colleges as professors, instructors, or foremen, viz.: One formerly Professor Botany and Horticulture in this College, now Professor Botany in Cornell University, one Professor Botany in Iowa Agriultural College, one Professor Analytical and Agricultural Chemistry in University of Wisconsin, one Professor Chemistry in University of Minnesota, one Professor Chemistry in Kansas Agricultural College; one Professor Physiology and Entomology in this College; one (not a graduate) Professor Agriculture in Kansas Agricultural College, one is Foreman of Gardens in this College; one Assistant in Chemistry, and one Instructor in Mathematics, both at this College; one is Assistant in Chemistry at Cornell University. Of those formerly connected with this College but now in other pursuits, one was Professor of Mathematics, now a clergyman and President of a Farmer's Club, which has an average weekly attendance of 200 for the year; one was Professor Botany in College of Maine, now a farmer in this State; one was Professor Horticulture at this College, now owns and works a fruit farm at Old Mission; one was Foreman of the College Gardens, now owns and works a fruit farm at Old Mission; one was Foreman of this farm, afterwards a farmer in Missouri; another had charge of the Government farm in Japan under supervision of Gen. Capron, but resigned on account of ill health, and is now on his own farm in Colorado; two are students in Animal Physiology, one a student of Veterinary Science, one a Manufacturer, two Druggists, four are Engineers and Surveyors, five are Lawyers, four are Merchants, Agents, etc.

The President and the Professor of Agriculture were both absent when I visited the College, and thus I failed to receive much information in regard to the details of the general management of the College and of the farm that they would have doubtless given me had they been at home. The Professors that I did see were quite ready to answer questions, and I was so favorably impressed with the management of their several departments, that I found myself thinking that chemistry, botany, zoology, and entomology were considered the important branches of study,—and I cannot but think that the College has been particularly fortunate in the professors of these branches. The chemical laboratory is so much in advance of those of the days when I was studying that branch of science, that it appeared to me to be perfection. An independent building, having a total length of 103 feet, and 51 feet for its greatest width, made of brick and stone walls, and situated a few rods apart from the other buildings, in a clump of oaks, and being two stories high, and entirely devoted to chemistry, gives ample accommodation for the most perfect instruction conceivable. The ventilation is the most perfect I have seen, and is so contrived that all injurious gases and bad air are removed to and carried off by a large chimney, whose entire height from the floor to the basement is 45 feet, four feet square, and divided by interior walls in separate flues. The whole building is divided into rooms for lectures, for chemical manipulations and analysis, private study and private laboratory, apparatus room, store and packing room, and, in short, every convenience that is required. In the laboratory 48 students may be engaged in making the same experiments, each having his table supplied with gas and water, as well as drawers and cupboards in which to keep apparatus, re-agents, etc. In a word each student's chemical estate, so to speak, is here represented, and all ordinary chemical work, and all operations not requiring special arrangements provided for in other departments, are here carried on, under the personal direction of the teacher, and in the presence of each other,—thus giving each student the advantage of seeing what his fellows are doing, and the measure of the success of each.

It is not strange that such instruction sends out professors and teachers for other institutions.

Not finding the Professor of Agriculture, Dr. Miles, at home, I did not learn as many particulars in regard to the practical management of the farm as I wished, but I saw the stock and crops as fully as I desired, and thought there was plainly to be seen a general management founded on good judgment, and very little that did not combine the useful so as to justify the cost. I was told that the farm had become self-sustaining, which, in view of all the circumstances, must be considered a success. For the farming for mere profit cannot be the leading object of such an institution, designed as it is for instruction. A single consideration will make this clear. The students require accurate information as to the characteristics of the various breeds of cattle, and just what constitutes the excellencies and defects of each, and their adaptability to various soils and circumstances. The only way to teach these things is to have specimens of these various breeds. So we find at the Michigan Agricultural College, bulls of the Galloway; Ayrshire, Devon, Jersey, and Short-horn breeds, as well as cows. These five breeds must each have distinct and expensive care. A farmer conducting this same farm for profit would own but one bull, and save the care of four that must be here stabled, fed, and cared for. This difference runs through the whole scale, and there is to be seen at the College, Essex, Berkshire, and Suffolk swine, Cotswold, and Lincoln, Spanish Merino, and Black-faced Highland sheep, and the institution must keep up not only these various families, but show good specimens, male and female, of each, and as time and money is given to it, must, in due time, breed horses, such as are most useful, and become the undoubted foundation of pure blood. This College should forever devote its attention to instruction, not money making.

Nothing remarkable in regard to the crops was observed. They were fully up to the average of those raised in the vicinity, but not much above. A field of some 17 acres was pointed out to me as devoted to root culture. Had Prof. Miles been present, I should have asked him to give me the figures, showing that this field would give better compensation for its use, and the manure and labor laid out on it, than it would had it been planted to Indian corn, and that corn cut up and put in stacks, and there left until wanted, or housed, as might be most convenient, but not husked. When required for consumption, drawn to a cutting machine driven by a steam-engine, and the exhaust steam used to cook stalks, leaves, and corn, cob and all, and then fed moist to farm stock, the cooking being sufficient to so soften the grain that none could be found undigested in the excrement of the cattle. This would be the minimum of labor and the maximum of benefit received. I know a man who does just this way with his corn crop, and after a full trial of roots he has abandoned their extensive cultivation in favor of corn, and he winters more than a hundred head of stock, 60 or 70 of them cows giving milk for city consumption, some of them fattening for the shambles.

I spent more than two weeks in the State of Michigan, and took considerable pains to inquire of doctors, ministers, and farmers as to the opinions of the people generally in regard to their Agricultural College, and in all cases was told that it was rapidly growing in public favor, and I heard nothing except in approval. I visited a farm of 640 acres in Livingston county, owned and managed by a man formerly from my own county of Onondaga, N. Y., who not only had one of the best farms I ever saw but every comfort about him—including accomplished sons and daughters—who appeared to take much pleasure in saying that one of his sons was educated in what he called "our College," and he evidently felt that "book learning" had helped to make him a good farmer, fit to inherit the wide fields his father had earned for him. The prejudice of the ordinary farmers against colleges in general is evidently fast wearing out in regard to this, for they are learning that their sons may come home from it with increased love for the old home, and for the business followed by their fathers. They find these college graduates have health of body combined with well-stored and cultivated minds; that they have an honest respect for work, and muscles, and tissues hardened and consolidated by regular systematic labor. They are proud of sons that they find to be their own equals in the harvest field, and only lacking age, and the experience that comes with years, to qualify them for the highest services to the State. The corrupted tastes, bad habits, and weakened constitutions that they have been accustomed to think were almost inseparable from liberable education they see their sons have escaped, and having been thus saved, no men are more proud of educated children than are farmers. They never objected to the books, or the things taught in college, but they did object to the habits and tastes acquired in ordinary college life, and finding that these evils have been eliminated at their college, they accept it as a most valuable means of elevating the position of the farming classes in the estimation of the public at large.

The influence of constant occupation, under the direction of instructors during college life, has been seen before, and I trust I will be pardoned for saying that, having spent part of my academic life at a military school, where all our time had to be accounted for, I speak from experience when I say that nothing can be better for the student than constant occupation under rules and orders. Three hours each day given to work, and four to six more devoted to study, will so fill up the time that but little will be left for outside amusements. At such an institution there will be no necessity for boat clubs and rowing races to harden the muscles and promote health, but a body of athletes will be given to society with every graduating class. The manual labor of the Michigan Agricultural College has this great advantage over the exercises of a military school, that the exertion made is turned to account, and helps pay the student's expenses, and thus the high education of the

College is brought within the reach of every energetic young man who really desires a liberal education. I will only add that at my visit to the College I saw no evil influences at work, and while it appeared to me that the institution was yet far from complete, that what had been done gave the best of evidence that the men who had done so much with so small means in so short a time would certainly, in due time, make the institution all that the most ardent friends of agricultural education desire.

REGISTER OF
METEOROLOGICAL OBSERVATIONS
FOR THE YEAR 1872.

TAKEN AT THE

State Agricultural College of Michigan,

BY R. C. KEDZIE,

PROFESSOR OF CHEMISTRY.

LATITUDE 42° 42′ 24″; LONGITUDE 7° 33′ 19″ WEST OF WASHINGTON.

Height above the Sea, 895 Feet.

ANUARY, 1872.

DAY OF MONTH.	OZONE — DAY OBSERVATION.	BAROMETER HEIGHT UCED TO FREEZING POINT.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		7 A. M.	2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	4		29.887	29.014	29.234	.086	.099	.071	100	64	69
2	7		29.098	28.958	29.078	.075	.142	.153	70	98	100
3	2		28.798	28.906	28.880	.196	.183	.181	100	90	100
4	5		29.051	29.061	29.054	.160	.170	.180	100	80	78
5	8		28.946	28.892	28.945	.105	.165	.170	75	72	80
6	½		28.128	29.205	28.808	.105	.129	.108	75	88	100
7	4		29.187	29.175	29.186	.171	.098	.059	100	100	65
8	5		29.152	29.162	29.156	.078	.130	.094	100	78	78
9	2		29.088	28.973	28 064	.082	.148	.105	61	89	75
10	8		28.946	28.866	28.939	.108	.155	.167	100	79	100
11	5		28.650	28.664	28.636	.155	.142	.155	89	70	79
12	4		28.690	28.606	28.701	.129	.169	.170	88	65	80
13	2		28.900	28.938	28.867	.155	.061	.108	89	47	100
14	------		29.035	29.184	29.078	.098	.098	.057	100	100	100
15	------		28.676	28,574	28.668	.101	.117	.135	86	76	100
16	------		28.986	29.079	28.952	.129	.128	.129	100	77	100
17	------		29.138	29.106	29.146	.096	.105	.111	85	75	86
18	------		28.883	28.817	28.869	.105	.118	.160	75	79	100
19	------		28.650	28.496	28.680	.167	.155	.147	100	79	100
20	------		28.638	28.688	28.654	.094	.175	.160	73	89	100
21	------		28.731	28.778	28.757	.117	.099	.082	87	64	100
22	7		28.292	28.448	28.483	.135	.111	.103	100	75	100
23	4		28.689	28.729	28.705	.065	.082	.071	100	100	100
24	7		28.921	28.969	28.907	.068	.101	.082	81	86	100
25	5		28.758	28.689	28.771	.071	.086	.065	100	100	100
26	5		28.529	28.768	28.629	.048	.080	.094	100	71	100
27	6		28.588	28.522	28.586	.086	.100	.082	100	74	100
28	7		28.522	28.654	28.571	.071	.068	.081	100	100	100
29	5		28.927	29.177	28.978	.046	.068	.042	100	100	100
30	6		29.162	29.106	29.149	.052	.055	.057	100	64	100
31	5		29.188	29.118	29.071	.050	.074	.040	100	88	100
Sums	------		---------	---------	---------	------	------	------	------	------	------
Me'ns	4.5		---------	---------	28.888	.108	.117	.108	94	77	98
Average		-----------------					.107			88	

EBRUARY, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	BAROMETER HEIGHT EDUCED TO FREEZING POINT.			FORCE, OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	4	29.118	29.115	29.125	.088	.051	.083	100	52	100
2	4	29.206	29.188	29.181	.028	.061	.088	100	47	100
3	5	28.958	28.867	28.940	.082	.061	.071	100	47	69
4	6	28.706	28.599	28.675	.084	.099	.141	71	64	100
5	7	28.991	28.972	28.980	.075	.141	.094	100	100	100
6	4	29.091	29.254	29.189	.062	.098	.082	100	56	100
7	4	29.118	29.118	29.172	.022	.098	.090	100	100	100
8	5	29.084	28.991	29.056	.052	.098	.098	100	56	100
9	5	28.988	28.880	28.946	.048	.162	.129	100	45	100
10	8	28.810	28.791	28.809	.091	.146	.108	85	86	100
11	4	28.758	28.789	28.779	.186	.241	.123	81	84	87
12	4	28.669	28.424	28.640	.082	.075	.091	100	70	85
13	7	28.803	28.498	28.857	.225	.123	.062	91	87	100
14	5	28.647	28.678	28.630	.048	.117	.108	100	76	100
15	7	28.696	28.688	28.695	.068	.101	.082	100	86	100
16	5	28.708	28.719	28.713	.042	.118	.094	59	48	78
17	5	28.791	28.794	28.785	.111	.094	.108	86	78	100
18	4	28.921	28.981	28.927	.090	.100	.071	100	74	69
19	5	28.904	28.929	28.941	.075	.088	.108	100	62	100
20	8	28.651	28.738	28.720	.117	.199	.168	87	90	89
21	4	28.631	28.836	28.786	.106	.178	.090	86	78	100
22	2	28.924	28.802	28.880	.040	.120	.094	100	61	100
23	2	28.442	28.420	28.474	.129	.165	.208	88	49	82
24	8	28.175	28.227	28.284	.257	.126	.221	100	49	100
25	1	28.898	29.052	28.888	.129	.167	.084	100	100	71
26	2	29.177	29.150	29.172	.045	.117	.094	60	76	78
27	4	29.081	29.029	29.065	.062	.180	.196	100	78	85
28	2	28.949	28.923	28.969	.090	.150	.129	100	80	88
29	1	28,860	28,919	28,875	.086	.105	.090	100	70	100
30	------	---------	---------	---------	------	------	------	------	------	------
31	------	---------	---------	---------	------	------	------	------	------	------
Sums	------	---------	---------	---------	------	------	------	------	------	------
Me'ns	4	---------	---------	28.842	.092	.108	.106	92	68	92
Average		---------	---------	---------		.100			84	

MARCH, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	BAROMETER HEIGHT UCED TO FREEZING POINT. 2 P. M.	9 P. M.	MEAN.	FORCE, OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION. 7 A. M.	2 P. M.	9 P. M.
1	2	28.874	28.847	28.888	.098	.117	.094	100	76	100
2	1	28.854	28.829	28.855	.108	.123	.087	100	87	84
3	5	28.696	28.676	28.782	.091	.142	.160	85	70	100
4	8	28.832	28.899	28.837	.065	.089	.086	100	72	100
5	5	29.111	29.075	29.102	.021	.080	.082	100	71	100
6	4	29.108	29.007	29.108	.040	.108	.082	100	100	100
7	1	29.178	29.103	29.170	.065	.185	.129	100	88	100
8	2	28.756	28.528	28.785	.103	.117	.118	100	76	100
9	8	28.410	28.454	28.416	.188	.155	.128	100	79	100
10	5	28.746	28.725	28.727	.117	.129	.141	76	61	100
11	4	28.942	29.028	28.938	.075	.148	.128	100	79	100
12	1	29.144	29.031	29.111	.059	.218	.094	65	76	78
13	8	28.755	28.885	28.802	.188	.262	.188	100	84	100
14	4	28.971	29.014	29.819	.098	.167	.108	63	100	100
15	1	29.214	29.130	29.187	.075	.186	.108	100	78	100
16	8	29.000	28.820	28.962	.059	.162	.071	65	89	51
17	4	28.795	28.795	28.794	.094	.155	.084	73	79	71
18	5	28.655	28.879	28.607	.078	.129	.188	59	61	100
19	2	29.019	29.006	28.980	.089	.098	.082	72	68	100
20	8	29.207	29.285	29.241	.081	.117	.048	100	76	100
21	4	29.208	29.164	29.201	.029	.094	.062	100	78	100
22	5	28.856	28.884	28.924	.050	.175	.167	100	89	100
23	8	28.658	28.858	28.707	.089	.117	.075	72	76	70
24	8	29.154	28.961	29.072	.055	.144	.108	100	68	100
25	2	28.947	28.964	28.948	.196	.186	.084	100	81	71
26	8	29.058	29.094	29.068	.117	.144	.105	76	68	75
27	8	29.005	29.025	29.028	.149	.170	.191	71	42	90
28	1	28.851	28.867	28.895	.168	.244	.181	89	60	100
29	8	28.945	28.940	28.951	.158	.120	.167	100	86	100
30	2	28.810	28.386	28.718	.186	.155	.181	78	79	100
31	4	28.898	28.660	28.404	.162	.181	.160	89	100	100
Sums	------	----------	----------	----------	------	------	------	------	------	------
Me'ns	8	----------	----------	28.911	.097	.145	.085	84	75	96
Average	----------	----------	----------	----------		.109			85	

APRIL, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	TH IN	BAROMETER HEIGHT UCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		7 A. M.	2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	3	25	29.011	29.018	28.977	.117	.170	.141	87	80	100
2	2	30	29.147	29.158	29.189	.167	.178	.143	100	73	79
3	3	24	29.180	29.212	29.186	.129	.170	.117	100	80	76
4	1	27	29.248	29.259	29.268	.147	.177	.167	100	66	100
5	2	28	29.184	29.091	29.149	.123	.234	.142	54	65	70
6	1	48	28.698	28.670	28.748	.165	.242	.259	49	45	100
7	5	48	28.549	28.640	28.577	.335	.497	.433	100	83	100
8	2	55	28.421	28.409	28.489	.405	.537	.487	94	71	94
9	3	56	28.481	28.500	28.424	.391	.365	.248	87	76	100
10	3	35	28.889	29.019	28.541	.188	.160	.212	90	64	100
11	3	40	29.029	28.916	29.012	.182	.283	.335	78	54	93
12	4	60	28.702	28.835	28.725	.396	.242	.212	76	52	63
13	1	41	28.920	28.985	28.969	.147	.152	.169	57	44	54
14	3	32	29.118	28.996	29.089	.148	.210	.212	79	58	100
15	6	30	28.846	28,979	28.895	.167	.181	.108	100	100	100
16	1	20	29.229	29.152	29.210	.108	.178	.168	100	60	89
17	1	41	28.957	28.871	29.025	.212	.322	.257	82	69	100
18	6	39	28.589	28.618	28.629	.216	.300	.238	91	100	100
19	2	43	28.639	28.628	28.631	.231	.325	.196	83	61	68
20	3	42	28.679	28.682	28.658	.177	.398	.380	66	56	76
21	4	53	28.733	28.921	28.781	.375	.248	.167	93	100	100
22	3	28	29.061	29.077	29.082	.123	.212	.158	100	100	100
23	1	38	28.727	28.688	28.768	.144	.282	.405	63	67	94
24	1	58	28.822	28.806	28.807	.269	.489	.429	67	62	77
25	3	60	28.791	28.836	28.828	.338	.342	.349	65	36	51
26	1	65	28.917	28.958	28.910	.389	.261	.216	63	38	46
27	4	50	29.091	29.100	29.088	.283	.408	.338	78	67	65
28	2	50	29.088	29.091	29.096	.258	.420	.262	71	68	84
29	3	47	28.998	28.989	29.018	.202	.409	.283	62	50	54
30	4	63	28.737	28.718	28.761	.416	.397	.502	72	34	78
31	------	---	---------	---------	---------	------	------	------	------	------	------
Sums	------	---	---------	---------	---------	------	------	------	------	------	------
Me'ns	2.63	---	---------	---------	28.852	.281	.292	.253	80	66	77
Average							.260			74	

F MAY, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	BAROMETER HEIGHT EDUCED TO FREEZING POINT.			FORCE, OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	2	28.697	28.749	28.647	.388	.418	.349	100	77	81
2	3	28.888	28.987	28.884	.248	.199	.212	100	74	100
3	2	28.836	29.047	28.863	.228	.210	.203	76	58	82
4	1	29.212	29.195	29.212	.173	.182	.199	78	61	74
5	⅓	29.115	29.046	29.109	.296	.442	.396	59	55	76
6	3	29.094	29.086	29.074	.430	.447	.446	61	40	77
7	3	29.008	29.023	29.016	.420	.550	.491	68	53	88
8	1	28.936	28.880	28.951	.423	.650	.545	88	54	67
9	1	28.767	28.827	28.783	.537	.510	.577	71	63	85
10	1	28.951	28.821	28.885	.403	.425	.487	100	64	94
11	2	28.641	28.768	28.725	.612	.618	.380	90	100	76
12	1	28.982	28.969	28.933	.286	.258	.254	92	71	92
13	1	28.984	28.881	28.956	.254	.394	.286	92	84	92
14	2	29.045	29.056	29.053	.321	.189	.391	74	81	87
15	4	29.149	29.122	29.128	.334	.348	.383	86	93	100
16	3	29.064	28.897	29.089	.348	.363	.396	86	43	76
17	2	28.731	28.721	28.739	.296	.678	.325	59	73	61
18	1	28.456	28.390	28.450	.309	.378	.420	64	62	94
19	2	28.418	28.493	28.422	.391	.348	.336	87	57	75
20	2	28.609	28.767	28.680	.334	.376	.278	86	87	100
21	3	28.875	28.844	28.871	.403	.269	.403	100	54	100
22	3	28.631	28.606	28.665	.388	.418	.335	100	100	100
23	3	28.840	28.776	28.807	.394	.442	.456	82	55	88
24	1	28.608	28.734	28.659	.487	.352	.405	94	70	94
25	2	28.791	28.737	28.778	.451	.353	.408	73	48	100
26	1	28.764	28.689	28.739	.524	.402	.469	66	45	94
27	1	28.676	28.824	28.709	.416	.438	.376	72	68	87
28	2	28.984	28.954	28.940	.225	.362	.308	70	55	79
29	2	29.023	29.000	29.018	.350	.469	.375	75	62	93
30	2	29.047	29.129	29.086	.374	.446	.363	100	77	81
31	3	29.165	29.129	29.148	.391	.389	.413	87	42	100
Sums	------	----------	----------	----------	------	------	------	------	------	------
Me'ns	2.14	----------	----------	28.868	.369	.397	.376	81	64	87
Average	----	----------	----------	----------	.380			77		

JUNE, 1872.

Day of Month.	Ozone—Day Observation.	Barometer Height Reduced to Freezing Point. 2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity, or Percentage of Saturation. 7 A. M.	2 P. M.	9 P. M.
1	2	28.984	28.918	28.951	.464	.759	.488	77	100	100
2	1	28.944	28.911	28.984	.502	.505	.689	78	56	100
3	1	28.828	28.774	28.834	.429	.601	.689	77	65	100
4	2	28.871	28.928	28.866	.336	.255	.396	75	49	76
5	2	28.906	28.886	28.914	.407	.410	.483	63	86	100
6	1	28.776	28.731	28.787	.420	.655	.449	68	81	100
7	4	28.486	28.496	28.507	.537	.706	.648	100	90	95
8	6	28.746	28.621	28.678	.500	.588	.658	100	62	90
9	4	28.658	28.626	28.645	.516	.595	.596	70	76	100
10	3	28.680	28.788	28.699	.518	.548	.478	100	79	83
11	2	28.787	28.777	28.797	.449	.610	.705	61	50	81
12	3	28.880	28.870	28.881	.516	.827	.808	64	42	69
13	6	28.614	28.694	28.687	.449	.536	.518	100	64	100
14	3	28.711	28.788	28.732	.456	.586	.413	88	80	77
15	1	28.854	28,881	28.859	.442	.516	.500	55	70	100
16	2	28.941	28.994	28.958	.612	.650	.865	90	59	76
17	2	29.043	29.068	29.066	.510	.691	.577	88	57	85
18	2	29.042	28.959	29.029	.668	.764	.655	86	56	81
19	1	29.998	28.998	29.000	.781	1.135	.897	81	80	100
20	½	29.010	29.058	29.032	.904	.974	.945	83	54	95
21	1	29.166	29.138	29.155	.482	.597	.563	66	58	94
22	2	29.066	29.050	29.074	.551	.768	.596	75	51	100
23	½	28.952	28.903	28.966	.591	.514	.556	69	54	100
24	1	28.892	28.868	28.892	.470	.498	.612	78	41	90
25	1	28.858	28.886	28.880	.577	.570	.682	85	47	90
26	1	28.904	28.888	28.902	.581	.610	.693	72	42	85
27	½	28.808	28.824	28.837	.785	.820	.745	82	50	86
28	1	28.888	28.861	28.879	.698	.970	.771	85	67	95
29	½	28.985	29.008	28.998	.705	.841	.745	81	60	86
30	½	28.978	28.930	28.972	.745	.833	.800	70	52	78
31	------	----------	----------	----------	------	------	------	------	------	------
Sums	------	----------	----------	----------	------	------	------	------	------	------
Me'ns	1.91	----------	----------	28.879	.602	.647	.599	83	61	90
Average						.616			78	

F JULY, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	T IN	BAROMETER HEIGHT EDUCED TO FREEZING POINT.			FORCE, OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		7 A. M.	2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	0	80	28.928	28.860	28.908	.758	.908	.818	74	60	83
2	1	78	28.857	28.814	28.865	.744	.874	.827	78	48	86
3	1	76	28.780	28.758	28.783	.691	1.868	.621	77	88	85
4	½	72	28.764	28.806	28.777	.681	.601	.422	81	65	46
5	1	66	28.947	28.980	28.946	.896	.417	.505	76	41	94
6	1	67	29.010	29.005	29.018	.489	.650	.529	75	59	89
7	1	78	28.976	29.005	28.999	.510	.638	.556	68	62	100
8	½	72	29.016	28.956	29.006	.559	.611	.708	72	88	100
9	2	76	28.918	28.858	28.912	.652	.974	.756	78	54	74
10	1	75	28.868	28.875	28.870	.705	.836	.685	81	65	100
11	1	73	28.819	28.825	28.853	.666	.814	.682	77	54	90
12	2	71	28.810	28.878	28.844	.668	.714	.788	86	42	100
13	1	71	28.973	28.975	28.989	.682	.778	.551	90	47	75
14	¼	84	28.808	28.868	28.871	.789	.960	.856	68	52	87
15	½	84	28.678	28.681	28.718	.789	.983	.785	68	70	100
16	¼	73	28.681	28.701	28.689	.785	.988	.812	90	87	100
17	2	74	28.834	28.869	28.829	.758	.664	.788	90	69	100
18	1	67	28.927	29.015	28.956	.457	.587	.470	69	54	78
19	¼	65	29.050	29.017	29.049	.488	.514	.518	78	54	100
20	1	64	28.886	28.807	28.891	.596	.787	.632	100	74	90
21	1	72	28.776	28.887	28.818	.550	.588	.429	72	62	77
22	½	61	29.000	28.968	28.984	.478	.554	.583	88	64	94
23	1	62	28.818	28.791	28.820	.556	.612	.596	100	90	100
24	½	67	28.970	28.997	28.972	.591	.664	.563	89	62	94
25	1	69	28.927	28.840	28.926	.599	.718	.685	85	86	100
26	½	72	28.867	28.956	28.872	.681	.599	.556	81	59	100
27	1	67	28.975	28.952	28.976	.591	.986	.596	89	88	100
28	1	72	28.985	28.944	28.946	.706	.677	.706	90	54	90
29	1	78	28.918	28.956	28.941	.655	.668	.666	81	57	77
30	½	65	28.942	28.872	28.947	.588	.652	.708	94	78	100
31	1	69	28.784	28.882	28.884	.708	.668	.556	100	57	100
Sums	......	...	....	....	....	......	......	......	......	......	......
Me'ns	.88	...	....	....	28.924	.628	.742	.648	78	62	91
Average			....				.671			77	

AUGUST, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	T… IN … 7 A. M.	BAROMETER HEIGHT …EDUCED TO FREEZING POINT. 2 P. M.	9 P. M.	MEAN.	FORCE OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION. 7 A. M.	2 P. M.	9 P. M.
1	¼	68	28.819	28.842	28.847	.577	.759	.549	85	67	89
2	½	65	28.860	28.956	28.894	.549	.577	.452	89	64	94
3	½	68	28.988	29.017	29.005	.577	.612	.488	85	62	100
4	½	58	29.060	29.066	29.067	.452	.778	.500	94	59	100
5	1	65	29.045	29.045	29.029	.549	.848	.708	89	83	100
6	1	68	29.006	28.996	29.019	.612	.915	.771	90	69	95
7	½	74	29.018	29.008	29.017	.641	.860	.718	77	57	86
8	½	77	28.988	28.970	29.003	.682	.800	.680	90	52	81
9	½	74	28.936	28.926	28.947	.680	.695	.706	81	95	90
10	1	71	28.952	28.949	28.947	.720	.731	.695	95	81	95
11	1	71	28.952	28.962	28.956	.720	.732	.612	95	90	90
12	½	66	28.967	28.937	28.964	.570	.691	.529	69	77	89
13	5	61	28.870	28.847	28.869	.587	.759	.639	100	100	100
14	2	63	28.888	28.867	28.842	.685	.516	.639	100	70	100
15	2	64	29.022	29,042	29.021	.529	.704	.548	89	78	94
16	½	64	28.955	28.987	28.976	.568	.561	.556	94	55	100
17	½	72	28.907	28.942	28.928	.595	.789	.785	76	68	100
18	1	72	28.992	29.022	29.003	.745	.758	.639	95	74	100
19	2	69	29.062	29.082	29.071	.685	.778	.788	90	59	100
20	1	72	29.096	29.064	29.091	.706	1.005	.897	90	67	100
21	1	77	29.014	28.945	29.018	.799	1.088	.816	86	77	75
22	½	79	28 948	28.978	28.956	.818	.705	.639	82	55	100
23	¼	66	28.964	28.954	28.996	.570	.846	.618	69	75	100
24	½	65	28.982	28.822	28.908	.451	.759	.591	78	67	89
25	½	72	28.872	28.926	28.876	.681	.915	.685	81	69	100
26	1	67	28.987	28.907	28.957	.662	.662	.695	100	100	95
27	2	68	29.017	29.017	29.019	.648	.601	.548	95	65	94
28	½	67	28.880	28.871	28.909	.662	.577	.549	100	64	89
29	1	65	28.748	28.861	28.791	.549	.666	.880	89	77	76
30	½	47	29.002	29.018	29.001	.298	.451	.890	92	78	98
31	2	47	29.089	29.050	29.049	.828	.505	.487	100	56	94
Sums	......	---	....	....	....	......	......	......	......	......	......
Me'ns	.98	---	....	....	28.967	.604	.728	.620	86	71	94
Average......			....				.650			88	

PTEMBER, 1872.

Day of Month.	Ozone—Day Observation.	TH IN 7 A. M.	BAROMETER HEIGHT DUCED TO FREEZING POINT. 2 P. M.	9 P. M.	Mean.	FORCE, Or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	RELATIVE Humidity, or Percentage of Saturation. 7 A. M.	2 P. M.	9 P. M.
1	2	56	29.091	29.085	29.093	.420	.561	.518	94	55	100
2	½	62	29.048	29.061	29.088	.523	.564	.466	94	79	100
3	1	53	29.077	29.040	29.081	.875	.898	.888	93	56	100
4	½	55	28.902	28.829	28.915	.876	.568	.570	87	67	89
5	½	67	28.662	28.649	28.678	.591	.792	.785	89	62	82
6	½	77	28.738	28.745	28.729	.841	.908	.799	91	60	86
7	1	72	28.858	28.861	28.848	.668	.836	.738	86	65	100
8	2	73	28.738	28.899	28.884	.698	.891	.644	85	70	86
9	1	66	28.904	28.919	28.917	.689	.928	.648	100	79	95
10	1	65	29.012	29.022	29.014	.549	.691	.596	89	68	100
11	2	69	28.866	28.842	28.891	.685	.895	.689	90	72	100
12	4	63	28.700	28.846	28.748	.576	.658	.488	100	90	100
13	½	58	29.069	29.189	29.109	.408	.482	.576	100	66	100
14	1	53	29.208	29.198	29.206	.408	.587	.861	100	71	100
15	1	47	28.905	29.008	29.029	.823	.524	.418	100	66	100
16	1	57	28.865	28.895	28.885	.466	.457	.348	100	69	100
17	½	48	28.905	28.808	28.871	.885	.429	.289	100	77	100
18	1	56	28.568	28.507	28.578	.886	.502	.874	75	78	100
19	1	5	28.819	28.955	28.822	.861	.407	.289	93	87	100
20	1	4	28.992	28.915	28.992	.800	.425	.890	100	64	98
21	2	5	28.765	28.809	28.796	.878	.612	.596	81	62	100
22	2	6	28.925	28.982	28.944	.604	.570	.466	94	89	100
23	½	6	28.900	28.906	28.923	.537	.656	.618	100	59	100
24	½	6	28.858	28.718	28.826	.570	.717	.621	89	70	85
25	1	5	28.817	28.802	28.786	.862	.296	.285	87	59	85
26	1	5	28.685	28.748	28.718	.256	.297	.278	61	55	85
27	1	4	28.871	28.928	28.881	.203	.308	.203	82	69	82
28	2	3	28.386	28.649	28.848	.162	.396	.449	89	76	100
29	5	4	28.469	28.680	28.825	.323	.348	.385	100	100	100
30	4	4	28.898	28.959	28.906	.311	.322	.300	100	92	100
31	------	--	----------	----------	----------	------	------	------	------	------	------
Sums	------	--	----------	----------	----------	------	------	------	------	------	------
Me'ns	1.4	--	----------	----------	28.890	.450	.562	.482	94	71	92
Average	------	--	----------	----------	----------		.498			85	

CTOBER, 1872.

Day of Month.	Ozone — Day Observation.	THE IN TE 7 A. M.	Barometer Height DUCED TO FREEZING POINT. 2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity, or Percentage of Saturation. 7 A. M.	2 P. M.	9 P. M.
1	2	43	29.030	29.022	29.029	.278	.309	.278	100	64	100
2	1	45	28.704	28.810	28.827	.300	.460	.388	100	83	100
3	1	52	28.675	28.762	28.734	.388	.509	.403	100	75	100
4	2	45	28.798	28.800	28.783	.300	.476	.449	100	69	100
5	1	58	28.827	28.847	28.837	.433	.614	.500	100	68	100
6	5	52	28.895	28.997	28.939	.361	.403	.300	93	100	100
7	2	42	29.100	29.100	29.053	.267	.242	.328	100	48	100
8	2	45	28.961	28.921	28.963	.300	.449	.433	100	61	100
9	2	57	28.836	28.841	28 858	.350	.489	.336	75	62	75
10	1	40	29.027	29.100	29.019	.248	.186	.208	100	67	91
11	3	30	29.105	28.999	29.088	.167	.199	.208	100	57	91
12	1	33	28.727	28.705	28.746	.186	.334	.323	51	86	100
13	1	40	28.669	28.811	28.720	.203	.335	.212	82	100	100
14	1	33	28.846	28.855	28.823	.188	.196	.174	100	68	100
15	2	36	28.485	28,496	28.964	.115	.218	.216	54	50	91
16	1	35	29.053	29.089	29.020	.183	.193	.167	90	44	100
17	3.	39	28.863	28.921	28.918	.288	.295	.311	100	63	100
18	2	31	29.080	29.117	29.087	.174	.255	.267	100	58	100
19	2	29	29.115	29.089	29.113	.160	.338	.221	100	65	100
20	2	30	28.919	28.904	28.955	.167	.367	.418	100	52	100
21	3	54	28.864	28.785	28.845	.282	.463	.378	67	56	81
22	2	46	29.086	29.200	29.027	.286	.283	.212	92	78	100
23	1	22	29.364	29.284	29.332	.101	.139	.142	86	89	88
24	2	22	29.290	29.267	29.314	.118	.256	.167	100	61	100
25	1	33	29.067	28.990	29.059	.208	.308	.300	91	79	100
26	4	45	29.146	28.785	28.950	.300	.348	.348	100	100	100
27	2	45	28.905	28.970	28.907	.275	.309	.199	92	64	74
28	2	34	29.199	29.269	29.216	.196	.268	.191	100	58	90
29	2	43	29.200	29.208	29.233	.278	.284	.249	100	51	77
30	1	43	29.024	29.007	29.043	.186	.269	.283	67	62	78
31	3	42	28.918	28.947	28.946	.267	.321	.209	100	80	75
Sums	......	......	....	....	....	......	......	......	......	......	......
Me'ns	1.93	......	....	....	28.979	.244	.359	.284	93	67	94
Average......			....	....	....		.295			84	

OVEMBER, 1872.

Day of Month.	Ozone—Day Observation.	T IN		Barometer Height Educed to Freezing Point.			Force, or Pressure of Vapor, in Inches.			Relative Humidity, or Percentage of Saturation.		
		7 A. M.		2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	1	39	1	29.021	29.000	29.004	.216	.210	.188	91	58	100
2	4	41	2	28.807	28.852	28.890	.257	.273	.278	100	85	100
3	3	42	0	28.990	29.058	28.991	.267	.245	.229	100	65	100
4	2	26	4	29.109	29.081	29.108	.141	.262	.278	100	84	100
5	7	42	0	28.811	28.886	28.875	.267	.311	.278	100	100	100
6	2	39	1	28.954	28.928	28.946	.238	.209	.175	100	75	89
7	4	33	0	28.398	28.608	28.508	.188	.167	.267	100	49	100
8	2	33	8	28.820	28.910	28.819	.138	.182	.221	100	61	100
9	3	24	8	28.961	28.911	28.956	.129	.192	.196	100	62	100
10	3	36	1	28.863	28.851	28.891	.170	.244	.241	80	60	84
11	5	50	9	28.824	28.897	28.830	.361	.254	.170	100	92	80
12	3	25	0	28.904	28.950	28.931	.135	.232	.167	100	78	100
13	3	39	5	28.614	28.696	28.715	.195	.209	.128	82	75	100
14	2	20	6	28.691	28.701	28.692	.108	.100	.108	100	74	100
15	6	27	2	28.722	28.798	28.787	.147	.117	.108	100	76	100
16	7	17	6	28.938	29.058	28.954	.094	.135	.101	100	88	86
17	6	17	3	29.065	29.207	29.171	.094	.117	.129	100	76	88
18	6	21	4	29.062	28.946	29.040	.118	.080	.108	100	71	100
19	5	1	3	28.761	28.742	28.780	.108	.111	.098	100	86	100
20	8	1	7	28.988	29.021	28.955	.078	.096	.078	100	85	100
21	7	14	2	28.772	28.746	28.800	.082	.136	.141	100	73	100
22	7	24	3	28.776	28.859	28.764	.129	.160	.160	100	100	100
23	5	27	6	28.848	28.868	28.855	.129	.165	.196	88	72	100
24	4	33	9	28.799	28.661	28.768	.168	.147	.235	89	57	91
25	4	32	3	28.978	29.046	28.984	.148	.136	.108	79	73	100
26	6	15	1	28.966	28.970	28.949	.086	.150	.108	100	80	100
27	5	19	4	29.049	29.193	29.025	.108	.074	.075	100	83	100
28	6	18	3	29.083	29.002	28.715	.078	.051	.065	100	68	100
29	7	7	0	28.967	28.818	28.936	.060	.096	.094	100	85	100
30	5	-	2	28.899	28.846	28.915	.040	.084	.093	100	71	100
31	......	--	---	....	....	....	......	......	......	......	......	......
Sums	......	--	---	....	....	....	......	......	......	......	......	......
Me'ns	4.5	--	---	....	....	28.881	.150	.166	.160	97	75	97
Average				....			.158			89		

ECEMBER, 1872.

DAY OF MONTH.	OZONE—DAY OBSERVATION.	TE IN	BAROMETER HEIGHT EDUCED TO FREEZING POINT.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY, OR PERCENTAGE OF SATURATION.		
		7 A. M.		2 P. M.	9 P. M.	MEAN.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.
1	5	19	4	28.495	28.468	28.525	.108	.185	.128	100	100	100
2	5	84	7	28.476	28.652	28.585	.196	.158	.148	100	100	89
8	6	27	2	28.877	28.975	28.904	.147	.155	.141	100	89	100
4	5	18	8	29.118	29.084	29.100	.087	.180	.185	84	78	100
5	6	29	7	29.027	29.080	29.004	.160	.168	.128	100	89	87
6	4	25	8	29.188	29.224	29.198	.185	.167	.094	100	100	100
7	5	22	4	28.911	28.549	28.844	.101	.155	.181	86	79	100
8	8	83	5	28.547	28.726	28.599	.168	.128	.094	89	87	100
9	6	8	2	29.024	29.092	29.039	.050	.067	.075	100	81	100
10	6	10	2	29.257	29.286	29.265	.068	.075	.094	100	70	100
11	6	8	6	29.278	29.816	29.810	.050	.106	.098	100	86	100
12	6	18	2	29.151	29.096	29.208	.098	.094	.118	100	78	100
18	5	28	4	28.745	28.821	28.826	.128	.105	.160	100	66	100
14	5	19	7	28.881	28.607	28.808	.108	.116	.186	100	58	81
15	7	15	8	29.082	29,086	29.028	.086	.096	.078	100	85	100
16	7	15	4	28.852	28.941	28.912	.086	.105	.070	100	75	82
17	6		2	29.148	29.105	29.111	.057	.094	.075	100	78	100
18	6	18	0	28.928	29.094	28.984	.098	.101	.062	100	86	100
19	7	-	5	29.122	28.893	29.188	.088	.090	.075	100	100	100
20	7	14	0	28.884	28.896	28.780	.082	.091	.062	100	85	100
21	5		8	28.969	29.055	29.010	.044	.046	.029	100	100	100
22	7	-2	6	28.907	28.786	28.989	.018	.085	.040	100	100	100
28	8	-	7	29.080	29.289	29.082	.040	.088	.028	100	100	100
24	5	-8	7	29.858	29.219	29.809	.011	.042	.085	100	100	100
25	6	-	6	29.019	28.961	29.056	.040	.068	.060	160	100	100
26	7		8	28.810	28.998	28.888	.062	.055	.022	100	64	45
27	7	1	7	28.9:8	28.956	28.950	.045	.091	.055	60	85	64
28	6		1	29.054	29.074	29.046	.009	.082	.068	18	84	100
29	6	1	9	29.189	29.211	29.188	.075	.128	.082	100	100	100
80	5	1	9	29.172	29.080	29.030	.086	.147	.129	100	100	100
81	5	2	5	29.182	29.205	29.118	.117	.185	.108	98	100	100
Sums	------	--	---	---------	---------	---------	------	------	------	------	------	------
Me'ns	5.81	--	---	---------	---------	28.992	.088	.102	.091	94	86	95
Average-----			------------------------------------				.092			91		

ABSTRACT OF METEOROLOGICAL TABLES FOR 1872.

BY R. C. KEDZIE.

In these tables the observations with thermometer in open air, of wet and dry bulb thermometer, of clouds, of winds, and of barometer, are taken at 7 A. M., 2 P. M., and 9 P. M., daily. The barometer is corrected for the temperature of 32° Fah. The force of the winds is estimated by the following table.

WINDS.

This is for the record of the direction *from* which the wind is blowing as indicated by a vane, and its force by estimation. The direction is entered in eight points of the compass: N., N. E., E., S. E., S., S. W., W., N. W. The force is estimated and registered by the following table, in figures from one to ten:

	Miles per hour.
1. Very light breeze	2
2. Gentle breeze	4
3. Fresh breeze	12
4. Strong wind	25
5. High wind	35
6. Gale	45
7. Strong gale	60
8. Violent gale	75
9. Hurricane	90
10. Most violent hurricane	100

ABSTRACT OF METEOROLOGICAL TABLES FOR 1872.

Mean height of barometer reduced to 32°, 28.687 inches.

Total amount of rain and melted snow, 26.84 inches.

Thermometer in open air, 45°.54.

Percentage of cloudiness, 57.

Humidity, or percentage of saturation with vapor of water, 82.

CHARACTERISTICS OF THE WEATHER IN 1872.

The chief characteristics of the weather in 1872 were dryness and cold. The rainfall for the whole year was more than 3½ inches less than the average. The temperature was 1°.69 below the average, while the month of December was more than 8° below the average temperature of that month, a fitting forerunner of the terribly cold winter of 1873. The period from December 22d to 25th will long be remembered as the severest "cold spell" ever witnessed in our State. On the morning of the 24th of December the thermometer stood at 32° below zero. This extreme cold was not confined to our State, but appears to have swept as a polar wave from Pembina in a southeasterly direction across Minnesota, Wisconsin and Michigan, thence easterly across Ontario and New York, and thence northeasterly to Quebec. The damage to fruit trees and the suffering which it caused to all classes will not soon be forgotten.

ABSTRACT OF RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT THE MICHIGAN STATE AGRICULTURAL COLLEGE FOR NINE YEARS—FROM 1864 to 1872—BY R. C. KEDZIE.

In the following abstract the mean daily temperature is given by months, for the nine years; the monthly rain fall; the average cloudiness, 100 being understood to represent the sky entirely overcast with clouds; and the average monthly moisture, by which is represented the percentage of saturation for that given temperature, 100 being used to represent complete saturation.

1864.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average for the year.
Mean daily temperature	22°.26	27°.32	31°.74	45°.86	60°.19	67°.63	74°.52	70°.72	59°.62	45°.74	37°.38	24°.37	47°.32
Rain and melted snow	.94	.27	2.26	3.80	2.87	3.88	1.25	.395	3.53	1.86	4.12	3.20	28.375
Cloudiness	69	69	68	76	62	48	46	68	66	72	73	77	66
Moisture	66	70	77	84	77	81	80	72	81	80	77	73	76
1865.													
Mean daily temperature	21°.10	27°.59	39°.96	47°.40	57°.65	70°.76	65°.60	65°.84	67°.66	46°.50	38°.63	27°.72	48°.12
Rain and melted snow	.65	1.76	2.79	2.32	1.77	3.55	3.91	3.38	4.79	2.76	.68	1.48	29.82
Cloudiness	77	75	68	70	54	54	64	58	68	54	54	75	63
Moisture	77	75	74	74	76	82	85	85	88	83	81	80	80
1866.													
Mean daily temperature	21°.16	22°.71	29°.60	48°.94	55°.04	66°.60	71.73	62°.60	55°.80	49°.50	37°.94	25°.53	45°.60
Rain and melted snow	2.08	2.28	3.39	1.40	3.48	5.37	4.19	3.44	5.80	3.57	2.60	1.90	39.51
Cloudiness	74	71	71	57	49	64	52	66	64	66	71	76	65
Moisture	82	81	83	64	59	74	74	81	85	82	81	79	77
1867.													
Mean daily temperature	17°.61	30°.89	29°.72	48°.20	51°.11	71°.61	71°.60	69°.78	56°.60	50°.60	40°.44	25°.31	46°.91
Rain and melted snow	1.68	3.23	.68	2.19	3.80	2.33	1.78	1.74	1.42	2.11	1.77	1.84	24.57
Cloudiness	76	71	72	60	69	46	44	39	37	45	56	78	55
Moisture	87	85	88	57	62	78	70	74	77	77	72	76	75

1868.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average for the year.
Mean daily temperature	19°.00	18°.72	37°.80	48°.68	59°.08	68°.46	77°.19	70°.88	58°.77	45°.19	36°.77	21°.16	46°.84
Rain and melted snow	1.47	1.28	4.65	1.83	2.30	3.55	1.11	2.42	2.95	1.11	2.44	1.35	26.45
Cloudiness	82	65	68	56	46	45	44	50	59	57	70	74	59
Moisture	80	83	87	75	66	76	77	73	80	73	84	90	79
1869.													
Mean daily temperature	29°.38	26°.66	27°.60	45°.70	56°.02	64°.45	70°.85	70°.58	63°.45	40°.80	32°.05	25°.16	46°.27
Rain and melted snow	.87	2.95	1.65	3.42	2.05	4.40	5.77	4.85	1.43	1.72	1.93	2.11	33.15
Cloudiness	66	71	67	61	70	65	58	48	41	68	77	78	59
Moisture	96	95	82	67	70	80	79	75	83	86	86	82	82
1870.													
Mean daily temperature	25°.87	24°.25	30°.28	50°.39	64°.32	70°.87	74°.40	70°.11	63°.66	52°.45	38°.40	24°.80	49°.11
Rain and melted snow	1.93	1.20	3.01	2.02	1.16	7.27	8.02	4.53	2.85	2.29	.91	2.57	37.76
Cloudiness	80	65	75	50	39	42	48	50	51	66	54	79	58
Moisture	85	84	84	76	73	77	79	81	83	85	80	94	83
1871.													
Mean daily temperature	24°.75	25°.65	33°.18	49°.80	61°.39	63°.21	70°.60	71°.19	58°.10	53°.91	31°.95	21°.12	49°.90
Rain and melted snow	3.95	1.73	3.91	2.97	1.97	2.93	3.10	1.42	.79	1.43	1.25	1.76	27.21
Cloudiness	82	69	66	63	37	42	49	44	43	53	69	81	59
Moisture	93	90	83	74	72	74	77	78	78	72	80	86	80

1872.													
Mean daily temperature	21°.59	21°.84	24°.75	47°.39	58°.48	71°.32	74°.91	71°.22	62°.03	47°.44	29°.80	15°.74	45°.54
Rain and melted snow	.42	.46	2.04	1.26	3.72	3.45	3.86	4.18	5.21	.67	.93	1.06	26.84
Cloudiness	71	50	54	52	60	49	47	50	48	47	69	72	57
Moisture	83	84	85	74	77	78	77	83	85	84	89	91	82

Average Results for Nine Years by Months.

	Avg'e monthly temperature.	Av'ge monthly rain-fall in inches.	Av'ge monthly snow-fall in inches.	Av'ge monthly percentage of cloudiness.	Temperature and Rain-fall by Years.		
						Temperature.	Rain.
January	20°.22	1.55	9.18	75	1864	47°.32	28.375
February	24°.90	1.77	10.66	66	1865	48°.12	29.82
March	32°.18	2.71	8.55	66	1866	45°.60	39.51
April	47°.46	3.47	2.66	61	1867	46°.91	24.57
May	57°.25	2.62	....	54	1868	46°.34	26.45
June	68°.94	4.13	....	51	1869	46°.27	33.15
July	72°.12	3.61	....	50	1870	49°.11	37.76
August	69°.15	2.71	....	52	1871	49°.90	27.21
September	59°.74	3.19	....	53	1872	45°.54	26.84
October	48°.01	1.95	.61	59			
November	35°.93	1.85	5.77	65			
December	23°.77	1.86	11.25	77			
Average yearly temperature, rain-fall, snow, and cloudiness for nine years	47°.23	30.41	48.68	61			

From this table it appears that January is our coldest month. Next in order of coldness is December; then February, March, etc.

The warmest month is July; next in this order is August, then June, etc.

The greatest rainfall is in June; next in this order is July, then April, etc.

The greatest snowfall is in December; next in this order is February.

July has least cloudiness and December the most.

If we compare the temperature by seasons we find that summer is warmer than winter by 47°.11—almost the average temperature of our year above zero. The fall months are warmer than the spring months by 2°.35.

The rainfall of summer (10.45 inches) is almost exactly double the quantity of rain and melted snow (5.18 inches) in winter. The difference between the rainfall of summer and winter varies greatly in different parts of the country. In New England the difference is less than 10 per cent; in New York it is nearly 50 per cent; in Virginia and the Carolinas it is 100 per cent; in Ohio, 25 per cent; in Wisconsin, 140 per cent; while in Iowa and Kansas it is 300 per cent. On the Pacific coast the reverse of this occurs, for the winter rainfall of Oregon is 7 times, and of California 20 times that of the summer fall of rain.

The rainfall of spring months exceeds that of the autumn by 1.81 inches.

If we take the six months from April to September as representing the warm season, and from October to March as embracing the cold season, we shall find the difference in the amount of rainfall very striking; the first period would give 19.73 inches; the second 11.49 inches.

The amount of snowfall varies greatly for different parts of our country. In Maine it is 7½ feet annually; in Vermont and New Hampshire, 6 feet; in Massachusetts, 4½ feet; in Connecticut, 3½ feet; in New Jersey, 2 feet; in Southern Ohio, 1½ feet, while at the Agricultural College it is 4 feet. In the western and northern parts of our State, near the great lakes, there is much more snow than in the central and southern parts.

LAWS ON AGRICULTURE.

◆

The statute law establishing the State Board of Agriculture, and providing for the Agricultural College, is as follows (see Compiled Laws of 1871, chapter 134, and Session Laws of 1873, Acts No. 145 and 157):

SECTION 1. *The People of the State of Michigan enact,* That a board is hereby constituted and established which shall be known under the name and style of the "State Board of Agriculture." It shall consist of six members besides the Governor of the State and the president of the State Agricultural College, who shall be *ex officio* member of the board; the Governor by and with the consent of the Senate, on or before the third Wednesday of January of each biennial session, shall appoint two suitable persons to fill the vacancies that shall next occur, which vacancies shall be so filled that at least one-half the members shall be practical agriculturists.

SEC. 2. The State Board of Agriculture shall be a body corporate, capable in law of suing and being sued, of taking, holding, and selling personal and real estate, of contracting and being contracted with, of having and using a corporate seal, and of causing to be done all things necessary to carry out the provisions of this act.

SEC. 3. Any vacancy in said Board, caused by death, resignation, or removal from the State, may be filled by a majority of the members. A majority shall be a quorum for the transaction of business. The members of the Board shall receive no per diem compensation for their services, but shall be paid their traveling and other expenses while employed on the business of the Board.

SEC. 4. They shall meet quarterly at stated times at the State Agricultural College, and may meet at such other times and places as they may determine.

SEC. 5. At their first meeting the members shall choose one of their number as president of their own Board.

SEC. 6. At their first meeting, or as soon after as a competent and suitable person can be obtained, they shall choose a secretary of the Board. If chosen from their own number, a vacancy shall be thus created in the Board. A treasurer shall also be chosen, at their first meeting, who may or may not be from the members of their Board, as they shall determine. They shall take such bonds from the secretary and treasurer as shall be deemed adequate to secure the faithful performance of their duties by those respective officers. The secretary and treasurer shall be chosen biennially, and shall hold their offices for two years from the last Wednesday of February, or until their successors are chosen.

SEC. 7. The Board shall direct the disposition of any moneys appropriated to the State Agricultural College.

SEC. 8. The secretary of the Board shall reside at or near the Agricultural College, and keep his office in the city of Lansing at the State buildings, or at the Institution, as the Board shall direct. It shall be his duty to keep a record of the transactions of the State Board of Agriculture, and of the State Agricultural College and farms, which shall be open at all times to the inspection of any citizens of the State. He shall also have the custody of all books, papers, documents and other property which may be deposited in his office, including specimens of the vegetable and animal kingdoms of the State or counties; also keep and file all reports which may be made from time to time by county and State Agricultural and Horticultural societies, and all correspondence of the office from other persons and societies appertaining to the general business of husbandry; address circulars to societies, and the best practical farmers in the State and elsewhere, with the view of eliciting information upon the newest and best mode of culture of those products, vegetables, trees, etc., adapted to the soil and climate of this State; also, on all subjects connected with field culture, horticulture, stock-raising and the dairy. He shall encourage the formation of Agricultural Societies throughout the State, and purchase, receive, and distribute such rare and valuable seeds, plants, shrubbery, and trees, as it may be in his power to procure from the general government and other sources, as may be adapted to our climate and soils. He shall encourage the importation of improved breeds of horses, cattle, sheep, hogs, and other live-stock, and the invention and improvement of labor-saving implements of husbandry, and diffuse information in relation to the same. He shall encourage such domestic industry and household arts as are calculated to promote the general thrift, wealth, and resources of the State. To effect these objects he shall correspond with the Patent Office at Washington, and representatives of our National Government abroad, and if possible procure valuable contributions to agriculture from those sources. He shall aid as far as possible in obtaining contributions to the Museums and the Library of the State Agricultural College, and thus aid in the promotion of agriculture, science, and literature.

SEC. 9. The seeds, plants, trees and shrubbery received by the Secretary, and not needed by the College, shall be, so far as possible, distributed equally throughout the State, and placed in the hands of those farmers and others who will agree to cultivate them properly, and return to the Secretary's office a reasonable portion of the products thereof, with a full statement of the mode of cultivation, and such other information as may be necessary to ascertain their value for general cultivation in the State. Information in regard to agriculture may be published by him from time to time in the newspapers of the State, provided it does not involve any expense to the State.

SEC. 10. Repealed by Act No. 157, Session Laws 1873.

SEC. 11. The secretary shall receive as a compensation for his services, a salary of one thousand dollars per annum, to be paid quarterly from the State Treasury, in the same manner as is provided by law for the payment of the salaries of State officers.

SEC. 12. The sum of twelve hundred dollars per annum for the years eighteen hundred and sixty-one and eighteen hundred and sixty-two, or so much thereof as may be esteemed necessary by the State Board of Agriculture, is also hereby appropriated to meet the expenses which may be incurred in the purchase and transportation of seeds, postage, and other contingent expenses of the office of secretary, and also necessary to pay the expenses of the Board in attendance upon their duties.

SEC. 13. The State Agricultural School, established by act number one hundred and thirty, Session Laws of eighteen hundred and fifty-five, in obedience to section ele ofven article thirteen of the constitution, shall be known by the name and style of the "State Agricultural College." The design of the institution in fulfillment of the injunction of the Constitution is to afford thorough instruction in agriculture and the sciences connected therewith. To effect that object most completely, the institution shall combine physical with intellectual education, and shall be a high seminary of learning, in which the graduate of the common school can commence, pursue, and finish a course of study, terminating in thorough theoretic and practical instruction in those sciences and arts which bear directly upon agriculture and kindred industrial pursuits.

SEC. 14. No student shall be admitted to the institution who is not fifteen years of age, and who does not pass a satisfactory examination in arithmetic, geography, grammar, reading, spelling, and penmanship.

SEC. 15. The course of instruction shall embrace the English language and literature, mathematics, civil engineering, agricultural chemistry, animal and vegetable anatomy and physiology, the veterinary art, entomology, geology, and such other natural sciences as may be prescribed; technology, political, rural, and household economy, horticulture, moral philosophy, history, book-keeping, and especially the application of science and the mechanic arts to practical agriculture in the field.

SEC. 16. A full course of study in the institution shall embrace not less than four years. The State Board of Agriculture may institute winter courses of lectures for others than students of the institution, under necessary rules and regulations.

SEC. 17. The academical year shall consist of not less than nine calendar months. This academical year may be divided into such terms by the State Board of Agriculture as, in their judgment, will best secure the objects for which the College was founded. The Board may at any time temporarily suspend the College in case of fire, the prevalence of fatal diseases, or other unforeseen calamity.

SEC. 18. Three hours of each day shall be devoted by every student of the College to labor upon the farm, and no person shall be exempt, except for physical disability. By vote of the Board of Agriculture, at such seasons and in such exigencies as demand it, the hours of labor may be increased to four hours or diminished to two and one-half hours.

SEC. 19. The State Board of Agriculture shall be vested with discretion to charge tuition or not, as they may deem most conducive to the interests of the institution, unless acts of the Legislature making appropriation for its support shall otherwise direct. The Board may make discriminations in regard to tuition between students from this and from other States, one-third of the tuition charged for the academic term shall be paid in advance, and shall be forfeited in case the student abandons the institution.

SEC. 20. The State Board of Agriculture shall have the general control and supervision of the State Agricultural College, the farm pertaining thereto, and lands which may be vested in the College by State legislation; and all appropriations made by the State for the support of the same, and also the management of any lands that may hereafter be donated by the General Government to this State in trust for the promotion of agriculture and industrial pursuits. The Board shall have plenary power to adopt all such ordinances, by-laws and regulations, not in conflict with this act, as they may deem necessary to secure the successful operation of the College and promote its designed objects.

SEC. 21. It shall be the duty of the State Board of Agriculture to choose a President of the State Agricultural College before the commencement of the next term of the institution; they shall then proceed to choose such professors, tutors and employes as the necessities of the institution demand. In case of vacancy in the office of President, or in case a suitable man cannot be selected, the President of the State Board of Agriculture, or such member of the Board as shall be designated by them, shall be President *pro tem.* of the College, who shall receive such compensation for his services as the Board shall determine.

SEC. 22. The Board shall fix the salaries of the president, professors, and other employes, and prescribe their respective duties. The Board may remove the President or subordinate officers, and supply all vacancies.

SEC. 23. The Board shall have power to regulate the course of instruction, and prescribe, with the advice of the faculty, the books to be used in the institution, and also to confer, for similar or equal attainments, similar degrees or testimonials to those conferred by the University of Michigan.

SEC. 24. The president, professors, farm manager, and tutors shall constitute the faculty of the State Agricultural College. The president of the College shall be president of the faculty. The secretary of the State Board of Agriculture shall be a member and secretary of the faculty.

SEC. 25. The faculty shall pass all needful rules and regulations necessary to the government and discipline of the college regulating the routine of labor, study, meals, and the duties and exercises, and all such rules as are necessary to the preservation of morals, decorum, and health.

SEC. 26. The faculty shall have charge of the laboratories, library, and museums of the institution.

SEC. 27. The faculty shall make an annual report by the first Wednesday of December of each year, to the State Board of Agriculture, signed by the president and secretary, containing such information and recommendations as the welfare of the institution in their opinion demands. Any members of the faculty may make a minority report if they disagree with the conclusions of the majority, which the faculty shall communicate to the Board. No communication at any other time from members of the faculty shall be entertained by the Board, unless they have been submitted to a meeting of the faculty and sanctioned by a majority.

SEC. 28. The President shall be the chief executive officer of the State Agricultural College, and it shall be his duty to see that the rules and regulations of the State Board of Agriculture, and the rules and regulations of the faculty be observed and executed.

SEC. 29. The subordinate officers and employes, not members of the faculty, shall be under the direction of the President, and, in the recess of the Board, removable at his discretion, and he may supply vacancies that may be thus or otherwise created. His action in these respects shall be submitted to the approval of the State Board of Agriculture at their next meeting.

SEC. 30. The President may or may not perform the duties of professor, as the State Board of Agriculture shall determine. If he performs the duties of a professor, or in case the duties of President are exercised by a President *pro tem.*, a Superintendent of the farm may be appointed, who shall have the general superintendence of the business pertaining to the farm, the land and other property of the institution, and who shall be a member of the faculty.

SEC. 31. The President and Secretary, together with the Superintendent of the farm, if there be one, and in case there is not one, then one of the professors to be elected by the faculty, shall constitute a committee to fix the rate of wages allowed to students and rate of board. In assessing the board it shall be so estimated that no profit shall be saved to the institution, and as near as possible at the actual cost. The rates of wages allowed and the rate of charge for board shall, if practicable, be submitted to the State Board of Agriculture before they take effect.

SEC. 32. For current expenditures at the State Agricultural College, specific sums shall be set aside in the hands of their treasurer by the State Board of Agriculture, which shall be subject to the warrants of the President of the College, countersigned by the Secretary. All moneys due to the institution or received in its behalf shall be collected and received by the Secretary, and deposited by him with the treasurer of the State Board of Agriculture. The secretary shall, with his annual report, render a full and complete account of all moneys received and all warrants drawn on the treasurer, as secretary of the College, and shall file and preserve all vouchers, receipts, correspondence or other papers relating thereto.

SEC. 33. The superintendents of the farm, horticultural, and other departments, the curators of the museums, and each of the professors shall make a written and detailed report of the workings of their several departments annually to the president of the College, which said reports shall be kept on file in the office of the secretary of the State Board of Agriculture. Agricultural operations on the farm shall be carried on experimentally, so far as shall be directed by the State Board of Agriculture, for the purpose of the instruction of the students, and with a view to the improvement of the science of Agriculture in the State of Michigan. And the said Board shall cause to be published in their annual report, so much of said reports of various departments, and of the results of the said experiments, as they may deem valuable to the agricultural, horticultural, and pomological interests of the State.

SEC. 34. All the swamp lands granted to the State of Michigan by act of Congress, approved September twenty-eight, one thousand eight hundred and fifty, situate in the townships of Lansing and Meridian, in the county of Ingham, and DeWitt and Bath, in the county of Clinton, of which no sale has been, or for which no certificates of sale have been issued by the Commissioner of the Land Office, are hereby granted and vested in the State Board of Agriculture, and placed in the possession of the State Agricultural College, for the exclusive use and benefit of the institution, subject only to the provisions relating to drainage and reclamation of the act of Congress donating the same to the State.

SEC. 35. The State Board of Agriculture shall have authority to sell and dispose of any portion of the swamp lands mentioned in the preceding section of this act, and use the same or the proceeds thereof, for the purpose of draining, fencing, or in any manner improving such other portions of said lands as it may be deemed advisable to bring under a high state of cultivation for the promotion of the objects of the State Agricultural College. The terms and conditions of the sale of the portions of the above described lands thus disposed of shall be prescribed by the State Board of Agriculture, and deeds of the same, executed and acknowledged, in their official capacity, by the president and secretary of the State Board of Agriculture, shall be good and valid in law.

SEC. 36. David Carpenter, of Lenewee county; Justus Gage, of Cass county; Philo Parsons, of Wayne county; Hezekiah Wells, of Kalamazoo county; Silas A. Yerkes, of Kent county, and Charles Rich, of Lapeer county, are hereby constituted and appointed the first State Board of Agriculture. At their first meeting, which the Governor of the State is hereby authorized and directed to call at as early a day as practicable, they shall determine by lot their several periods of service, two of whom shall serve for two years, two of whom shall serve for four years, and two of whom shall serve for six years, respecttively, from the third Wednesday of January last past, when they are superseded by appointments, in accordance with the provisions of section one of this act, or until their successors are chosen.

SEC. 37. Act number one hundred and thirty, session laws of eighteen hundred and fifty-five, being an act for the establishment of a State agricultural school, and all other acts or parts of acts in conflict with the provisions of this act, are hereby repealed.

SEC. 38. This act shall take immediate effect.

[Act No. 157, Session Laws 1873.]

SEC. 8. The Secretary of the State Board of Agriculture shall report to the Legislature at every regular session thereof, and to the Governor on the first Wednesday of January of each year when the Legislature is not in session. His report shall embrace all statements, accounts, statistics, prize essays, and other information relative to agriculture in general, proceedings of the State Board of Agriculture, of the State Agricultural College and farm, of the State Agricultural Society, and of the county and district agricultural societies, to be approved by the Board. Of this report there shall be printed and bound six thousand copies annually; two thousand copies to be placed in the hands of the Secretary of State for distribution; one copy to be furnished to each newspaper; and the remaining four thousand copies shall be placed at the disposal of the State Board of Agriculture; one thousand copies to be distributed by the Secretary of said State Board of Agriculture, as the Board shall direct, and the remaining three thousand copies to be distributed by the first of January in each year, by the Secretary of the Board to the secretaries of the various district and county societies, as equally as may be, according to the population of said counties, to be by said secretaries distributed among the various viewing committees of county and district fairs, giving one volume of such report to each of said committees as shall be present and discharge the duties of the office on the days of the county and district fairs.

ACT RELATIVE TO THE STATE AGRICULTURAL COLLEGE, AS PASSED BY THE LEGISLATURE OF 1873.

[Act No. 88.]

AN ACT making an appropriation for the support of the Stae Agricultural College, to pay the arrearages of the same, to pay the expenses of the State Board of Agriculture, and for buildings and other improvements at the Agricultural College.

SECTION 1. *The People of the State of Michigan enact*, That there shall be and is hereby appropriated out of the State treasury the sum of fifteen thousand dollars for the year one thousand eight hundred and seventy-three, and the sum of thirteen thousand dollars for the year one thousand eight hundred and seventy-four, for the use and support of the State Agricultural College, and to pay the expenses of the State Board of Agriculture; also the sum of six thousand seven hundred and ninety-six dollars, to pay the arrearages of the State Agricultural College, which said arrearages shall be paid in the year one thousand eight hundred and seventy-three.

SEC. 2. There shall be and is hereby appropriated out of the State treasury the sum of eighteen thousand dollars to erect and finish a president's house and two professors' houses; also eight thousand dollars to erect a green-house; also three thousand seven hundred and sixty-four dollars for the improvement of buildings and grounds at said College; also the sum of one thousand four hundred and forty dollars for the library and chemical laboratory of said College, said amounts embraced in this section, aggregating thirty-one thousand two hundred and four dollars, to be paid, one-half of the same in the year one thousand eight hundred and seventy-three, and one-half of the same in the year one thousand eight hundred and seventy-four; which said moneys provided for in this act, or so much thereof as may be necessary, shall be expended under the direction and control of the State Board of Agriculture for the purposes aforesaid, and shall be drawn from the treasury on the presentation of the proper certificates of the said board to the Auditor General, and on his warrant to the State Treasurer.

SEC. 3. There shall be assessed upon the taxable property of the State in the year one thousand eight hundred and seventy-three the sum of thirty-seven thousand three hundred and ninety-eight dollars, and in the year one thousand eight hundred and seventy-four the further sum of twenty-eight thousand six hundred and two dollars, assessed and levied in like manner as other State taxes are by law levied, assessed, and paid, which tax when collected shall be credited up to the general fund, to reimburse to the same the sum to be drawn therefrom, as provided in sections one and two of this act.

SEC. 4. This act shall take immediate effect.

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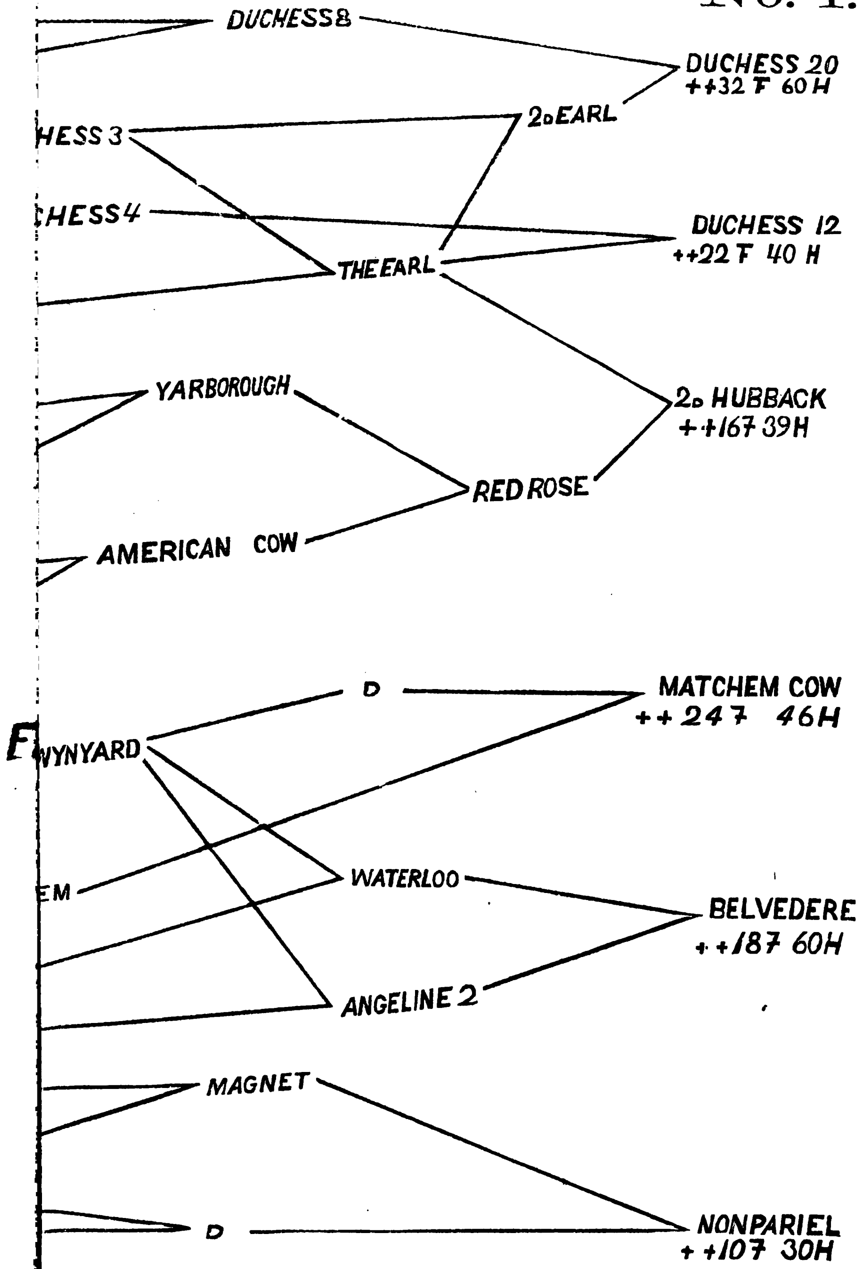

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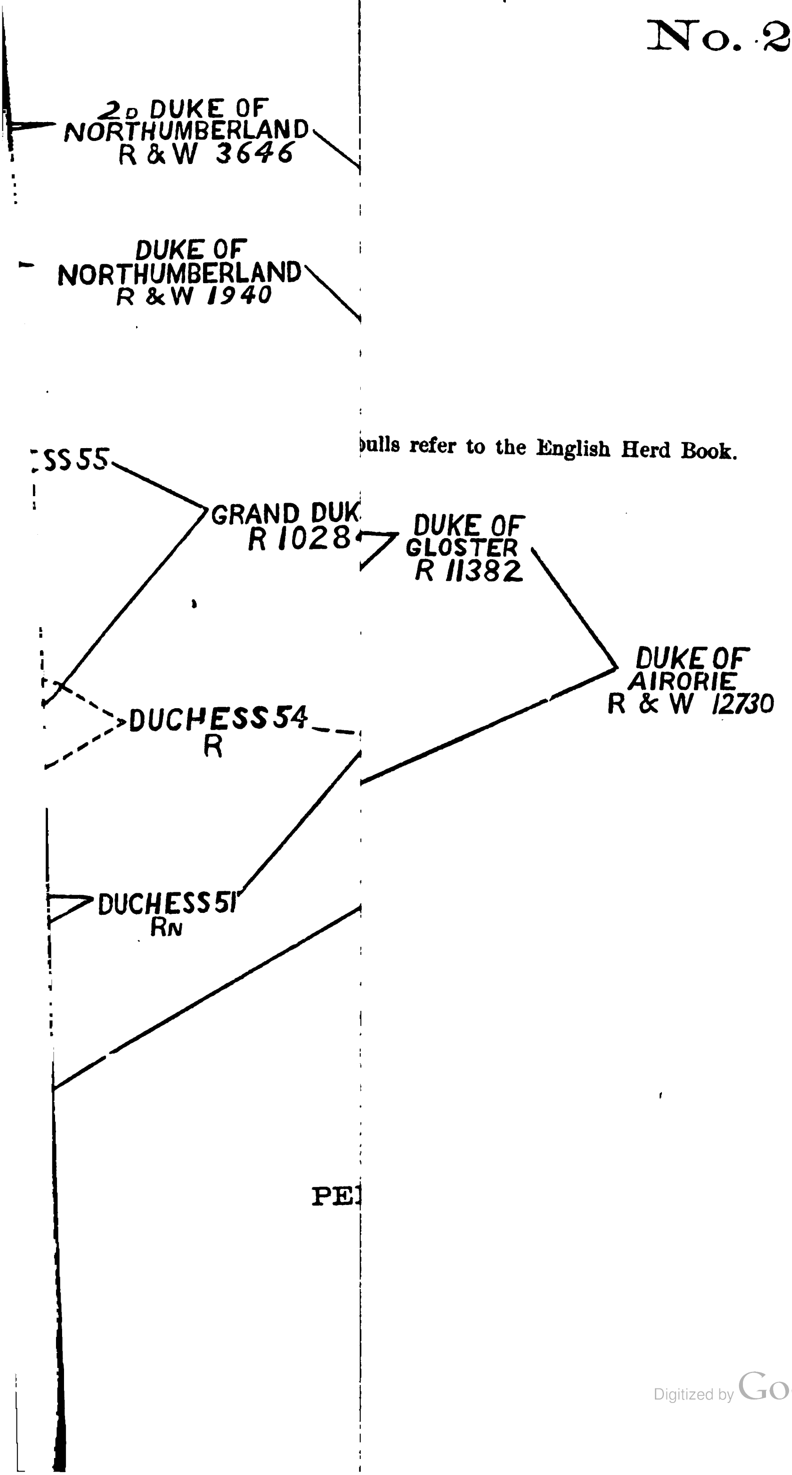

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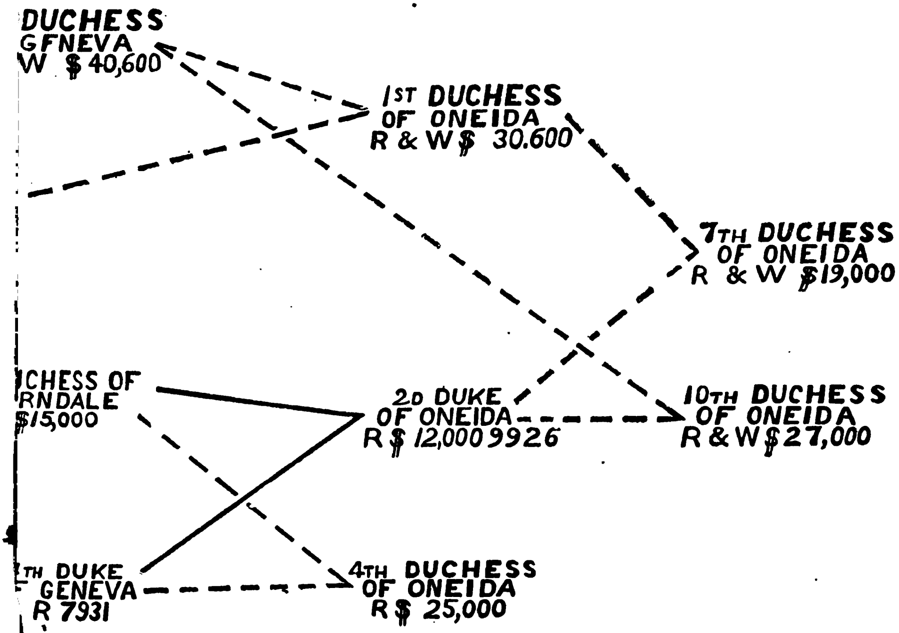

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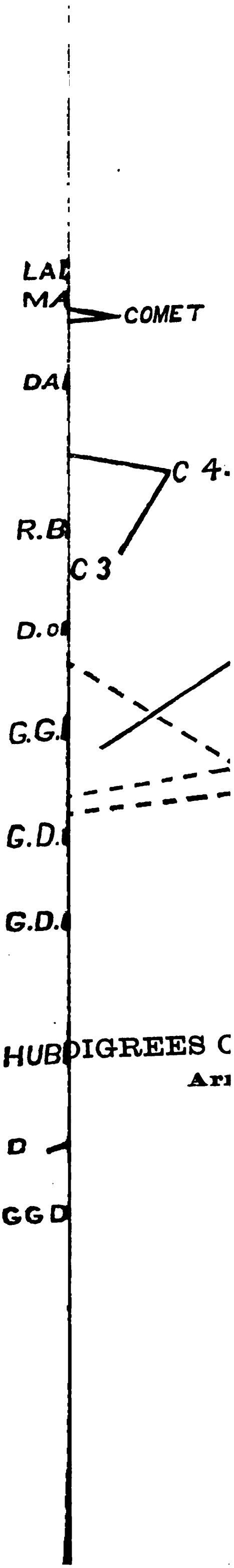
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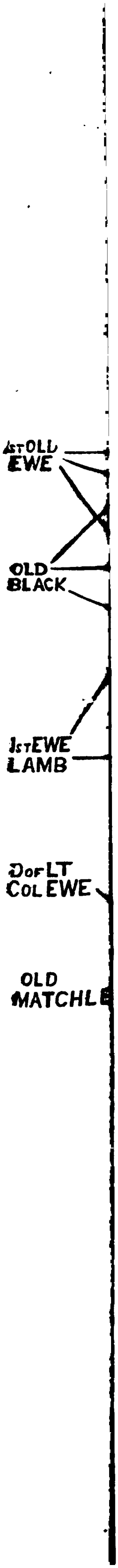
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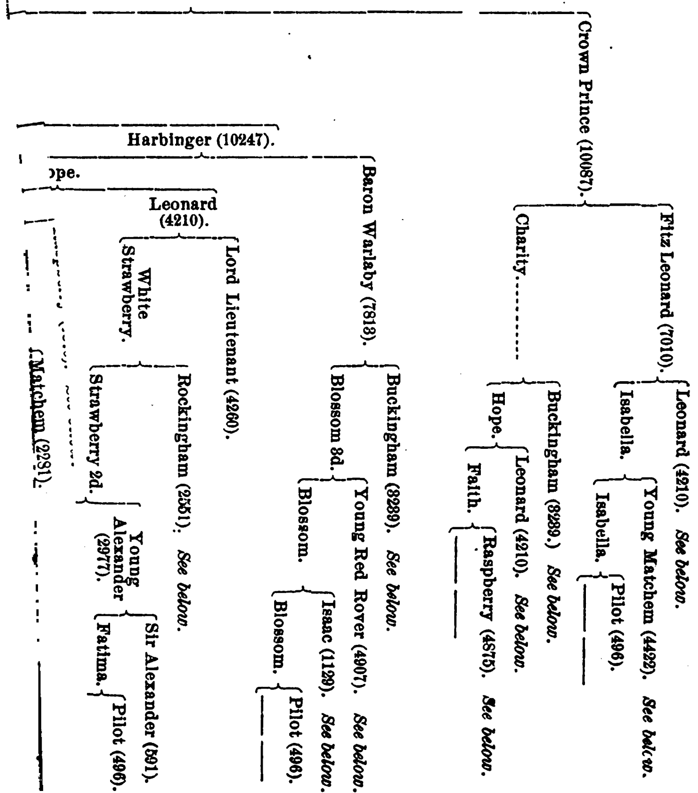

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